CITY OF NEW YORK

Department of Bridges

REPORT

OF THE

COMMISSIONER

1904

CITY OF NEW YORK,

DEPARTMENT OF BRIDGES.

REPORT

OF THE

Commissioner of Bridges

TO THE

Hon. GEORGE B. McCLELLAN,

Mayor of The City of New York.

DECEMBER 31, 1904.

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OFFICE OF THE COMMISSIONER OF BRIDGES,
NEW YORK, December 31, 1904.

Hon. GEORGE B. MCCLELLAN,
Mayor, City of New York:

DEAR SIR—In response to your request, I beg leave to submit the following statement as to work done in the Department during the past year:

A number of contracts for bridges had been let during the last quarter of 1903, and one of the largest of these was let on general plans, leaving the detail or working plans to be prepared by the contractor, and a great deal of time during the past year has been given to working out the details of these plans.

Efforts were made early in the year to secure the reconstruction of the westerly or Manhattan terminal of the Brooklyn Bridge, under chapter 712 of the Laws of 1901, and an attempt was made to secure the extension of the bridge railway tracks across Centre street, pending the construction of a complete terminal. This was stopped by litigation, and I have again asked the Board of Estimate and Apportionment to authorize its construction.

Contracts were made for the construction of the railway tracks over the Williamsburgh Bridge. The southerly tracks were completed and cars commenced running on these tracks on the 3d of November, under a traffic agreement entered into for the operation of trolley cars on the bridge. This agreement was contested in the courts, a temporary injunction was dissolved, and decision has just been rendered sustaining the traffic agreement.

The plans for the Manhattan Bridge were changed early in the year, so as to provide for a wire cable suspension bridge instead of an eye-bar cable bridge, as had been previously projected. Bids for the anchorages will be opened the 22d of this month, and the plans for the steel work are well advanced.

Plans for the Blackwell's Island Bridge have been developed by the contractors, work is in an advanced stage in the shops, and the erection will begin in the field within a few weeks.

Contract was let for the bridge over Flushing creek, and work has been well advanced on the Vernon Avenue Bridge, in the Borough of Queens, and the Pelham Bay Bridge, in the Borough of The Bronx, as well as on the bridges over the Gowanus canal.

Plans should be prepared and contracts let during the coming year for the completion of the Fordham Heights Bridge and the new Madison Avenue Bridge over the Harlem river; for the Borden Avenue Bridge over a branch of the Newtown creek; for the superstructure of Pelham Bay Bridge and the reconstruction of the Unionport and Eastchester bridges.

Brooklyn Bridge.

This bridge has been kept under constant surveillance and careful inspection, and is now in first-class condition. The number of passengers crossing it has increased so that about 36,000 passengers now cross in the bridge trains in a single rush hour at night; this means that the cars, which seat about forty people, actually carry three times that number during one rush hour, from 5.30 to 6.30 P. M. These passengers are crowded into the cars and on the station platforms in a most disgraceful manner.

In 1890 careful estimates were made of the probable future travel on the bridge, and the number of passengers now carried in the busiest hour of the day is 40 per cent. greater than the maximum capacity then believed to be practicable with the length of train and number of trains now run, and it was estimated that the number of passengers now carried would not be reached until 1920. Obviously the growth of travel has increased beyond any figure then reasonably expected, and it is hardly possible that the number of passengers carried will be diminished; it must increase until the Manhattan Bridge can be completed and put in operation to relieve the pressure on this structure.

The completion of the subway, with its principal station directly in front of this bridge, will certainly increase the present intolerable conditions. Much time will be required to completely reconstruct the Manhattan terminal and build the large station now projected as a joint City Hall terminus for the Brooklyn and Manhattan bridges, but it is certain that the extension of the bridge tracks across Park row and onto the subway plaza will permit the use of a greater number of trains and the more rapid movement of these trains and nearly or quite double the platform areas and the convenience of access thereto. This construction

over Park row would be temporary, pending the completion of the large station, and should be commenced at once and completed if possible before the heavy travel of the summer begins. There is no good reason for delaying this work, the plans for which have now been changed so as to avoid trespassing on the grass plots of the City Hall Park; failing to secure this measure of relief the conditions at the Manhattan terminal must grow steadily worse, and they are now so bad as to seem unbearable.

The extension over Park row must be temporary in any event, for the larger station cannot be operated without its removal, and the necessity for its existence will disappear, at latest, with the completion and full use of the Manhattan Bridge. This extension will not be more unsightly than the present terminal, and the relief which it is certain to give would seem to justify fully the temporary continuance of an unsightly structure at this point. Unfortunately the few interests which oppose its construction are those which never or rarely ever use the bridge, and have thus far outweighed the interests, convenience, comfort and even safety of the millions who must use the bridge.

Williamsburgh Bridge.

This bridge was opened to public travel on the 19th of December, 1903, one roadway only being available for use.

The creo-resinate block pavement was 75 per cent. completed at that time, and was entirely completed on the 17th day of January, 1904.

The kosmocrete sidewalk was 90 per cent; completed, and was fully completed on May 26, 1904.

The roadway pavement on the approaches was 70 per cent. completed, and was entirely completed on May 17, 1904.

Concreting the anchor chain tunnels was 94 per cent. completed, and was fully completed on April 22, 1904.

The footwalk flooring was 15 per cent. completed, and was fully completed on May 13, 1904, and the south footwalk was opened to public travel on May 7 and the north footwalk on May 28.

The comfort station contract was let last year, but the work was not started until the beginning of this year, and about 98 per cent. is now completed.

The grading and paving of the Brooklyn plaza was 15 per

cent. completed on the 1st of January, and was fully completed in November.

The electric wiring contract, let but not started last year, was completed on July 16, 1904.

The hoods over the cable saddles, contract let, but work not started last year, were completed in August, 1904.

The asphalting under the Manhattan approach was completed in June, 1904.

The elevated railway and trolley tracks were completed November 3, 1904.

The overhead trolley and plaza loops were completed in December, 1904, and the conduit tracks for the use of the New York City Railway Company are about 80 per cent. completed.

On November 3, 1904, the Brooklyn Heights Company, the Coney Island Company and the Bridge Operating Company started the operation of trolley cars on the south tracks of the bridge.

Owing to the fact that the ground designated as a plaza on the Manhattan side of the Williamsburgh Bridge had been given over to street purposes, it was not available for this Department. Adequate facilities for car service cannot be constructed on the Manhattan side, and the cars commenced operating and are operated on a very meager and inadequate terminal. But, notwithstanding the condition of this terminal, more than 1,000 round trips per day have since been made by the trolley cars on the south tracks of the bridge, and something like 30,000 passengers per day are carried in these cars.

It is of the utmost importance that the ground designated as a plaza on the original maps of the bridge should be restored to the control of this Department, in order that something like adequate accommodation may be afforded the cars and passengers at the Manhattan end of the bridge.

The travel on the roadways of the bridge has fully equaled the anticipations, and the receipts per month now aggregate about $5,000, against $6,000 on the Brooklyn Bridge.

Manhattan Bridge.

In all probability this bridge will be the most efficient of any of the large bridges now authorized over the East river. It is provided with a middle roadway, 35 feet in width, and with eight railway tracks, four for trolley cars and four for elevated railway trains.

This bridge, with the Flatbush avenue extension, will form a wide avenue, virtually from Prospect Park to the junction of Canal street and the Bowery, which may be continued through the wide avenue of Canal street to the North river. The bridge will form an important link, therefore, in a wide highway from the ocean to the North river through the central portion of the city.

It is, I think, unfortunate that the Fatbush avenue extension should not be continued as a part of the approach to this bridge, for this wide avenue will require some of the most careful and skillful treatment to adapt it to the needs of traffic . It is proposed to extend the Fourth avenue subway from Fort Hamilton through this avenue over the Manhattan Bridge. Whether this will be found practicable or not, it is certain that the construction of the Flatbush avenue extension is intimately connected with the construction of the bridge. The work on each should be conducted in harmony with the work on the other, for here is perhaps the greatest opportunity in the city for the development of a highway for travel of maximum efficiency. It is important, if possible, that it should be ornamental, but it must be useful, or the money devoted to its construction will be wasted, and it is of the utmost importance that the avenue and the bridge should be constructed in the shortest practicable time.

The preparation of the plans for this bridge was first authorized on November 30, 1898. Early in 1902 the plans for the superstructure of a wire cable suspension bridge had been developed, and had these plans been adhered to contracts might have been let for this type of bridge before the close of the year 1902. It was, however, determined to change these plans and prepare plans for an eye-bar cable bridge, using nickel steel for the eye-bars. Now, while the eye-bar form of construction is one of the earliest that was ever used for suspension bridges, it went out of use, because of the limitation of the size of eye-bars which could be manufactured and their efficiency, nearly sixty years ago.

It is true that a highway bridge of something like one thousand feet span was built in Budapest on this principle within the last five years, but the eye-bars were cut from steel plates, and not forged, as they would have to be for a larger and heavier bridge; and it is a fact that the bids for a wire cable bridge were lower than for a plate eye-bar bridge, and would have been more rapid of execution in this place, but the question was decided in favor

of the plate eye-bar construction, because the material could be made in Hungary, and the question of the use of home products determined the matter.

Here, then was a structure designed in the middle of 1902 of a type which had never before been constructed on the scale here proposed, and it involved the use of a steel which has never yet been used in bridge construction. We are just now making nickel steel eye-bars for the Blackwell's Island Bridge 16 inches in width, with 16-inch pins, and the difficulties of securing this material render it almost certain that from one to two years would be necessary to develop the larger eye-bars of nickel steel required for the Manhattan Bridge.

The calculations show that there are 10,000 tons more steel in the eye-bar type of bridge for this location than will be required for the wire cable construction, and notwithstanding the fact that statements diametrically opposed to this are made, I am convinced that the wire cable suspension bridge can be built in one-half the time, and at very much less cost, than the eye-bar bridge.

In the preparation of the plans for the eye-bar bridge none of the essential details were worked out on a practical basis, and while a contract could have been let on the plans prepared, it is certain that more than a year's time would have been required for the contractor to determine the details of construction before any work could be done.

The City of New York already owns two wire cable suspension bridges, both of them of spans exceeding that for the Manhattan Bridge by nearly 150 feet. The valuable work that these bridges have done, the ease and facility with which these bridges were constructed, the certainty of knowing within a reasonable time when the bridge would be completed and with close proximation what it would cost, the knowledge that the wire cable bridge would make a satisfactory bridge, and the experimental nature of the eye-bar bridge and the uncertainty as to its action under the traffic imposed, led me to reject the plans for this bridge, especially as I believed that they had not been legally approved by the City authorities, and to substitute therefor the wire cable bridge, which was anticipated in the original authorization and which I believed would give the safest bridge, at the least cost and in the least time.

The plans for the wire cable bridge were approved by the Art Commission in September last, and the preparation of detailed

plans was at once commenced. Bids for the anchorages were received on the 22d of the present month, and contracts for the steel superstructure will be let during the early part of the year 1905.

The methods of construction of this type of bridge are not in the least experimental, they are well understood and familiar to us all, and I believe that there is no good reason why the bridge on this plan should not be completed and opened for traffic early in the year 1908, while there is no experience to found an opinion on and no good reason to believe that the eye-bar bridge could be completed before the year 1910.

The Manhattan Bridge as designed will, I believe, be one of the handsomest bridges that has ever been built in the world, and I believe that it will be built at less cost and in less time than any other structure of corresponding magnitude.

The wildest vagaries of vigorous imaginations and concentrated prejudices have led the uninformed to entertain and utter malevolent and iniquitous statements as to the motives for changing the plans for this bridge. These expressions, however, have not deterred me from the performance of what I believed to be the clear, clean duty of building this bridge on a recognized type of construction and removing it as far as possible from the realm of untried experiment.

Blackwell's Island Bridge.

The work on the erection of the steel superstructure of this bridge has commenced and will reach an advanced stage during the coming year, and it is expected that contracts will be let for so much of the approaches as is covered by the original plans. More land must be taken on the Manhattan side to provide for terminals at that point, and these terminals must be studied with great care.

On the Queens side we should have more width of land for the approaches, and although not now perhaps directly within the jurisdiction of this Department, provision should be made for carrying a viaduct, preferably as an approach to this bridge, across the low ground of Jackson avenue and the extensive railroad yard which the Pennsylvania Railroad is building at this point. This is a matter of the very greatest importance, not especially to Long Island City, but to millions of people who must eventually reside in the Borough of Queens, between Long Island City and the easterly boundaries of the borough.

Realizing that bridges of this character cost immense sums of money, and are not likely to be easily duplicated, and in view of the fact that the large bridges should be given the greatest capacity possible, I have thought it advisable, at a slight increase only in cost, to recommend the construction of this bridge so as to provide for the addition of two elevated railway tracks in the future, in case it should be deemed necessary to build them.

Harlem River Bridges.

At the Willis Avenue Bridge an approach from the Southern Boulevard is now under contract and will be ready for public use early in the summer of 1905. This improvement will be of great benefit to the rapidly growing district to the north and east of the bridge.

The Madison Avenue Bridge, at One Hundred and Thirty-eighth street, is carrying an ever-increasing amount of traffic, for which the structure is quite inadequate. The project of a new bridge at this point has been under discussion for some years, and land necessary for its approaches is now being acquired. The approximate cost of a new Madison Avenue Bridge of modern equipment and of sufficient capacity will be $1,750,000, and it is very desirable that the work of construction should begin early in the coming year.

The One Hundred and Forty-fifth Street Bridge, which was authorized nearly ten years ago, was stopped early in 1902 to permit the construction of the Rapid Transit tunnel across the Harlem river, which was located so near this bridge as to make it difficult or impossible to conduct both pieces of work at the same time. It was not until the late summer of this year, and then only through vigorous effort and the friendly action of the contractors for the tunnel, that we were able to resume work on the construction of this bridge, which had laid idle for more than two years. This bridge will be opened for public travel before July, 1905, and should afford a very convenient avenue between the boroughs of Manhattan and The Bronx.

The New York and Putnam Railroad Bridge, which crosses the river at One Hundred and Fifty-eighth street, has a footwalk for public use to which the City, in 1892, built and has since maintained approaches. They are built of wood on the railroad company's land and were intended to be temporary. The approach on the Bronx side, from Sedgwick avenue to the railroad bridge, is in

bad condition, and must soon be radically repaired or a new bridge built. With the consent of the Commissioner of Parks, an ornamental structure can be built on the north end of Macomb's Dam Park, which will be in harmony with the improving conditions of the locality, and be adequate to carry the rapidly increasing travel. The number of foot passengers now using this bridge is 2,600 per day.

A centre pier at Two Hundred and Seventh street or University Heights Bridge has been built during the year, and the construction of the bridges and approaches, together with the elimination of the Fordham Landing grade crossing of the New York and Putnam Railroad, will be proceeded with as soon as an appropriation for the purpose can be secured. The plans for this bridge will be presented to the Art Commission in a few days.

The rebuilding of the Ship Canal Bridge, in order to accommodate the Rapid Transit Subway construction, necessitates the removal of the bridge now at that site, which is a comparatively new bridge and in excellent condition. The plan for the Rapid Transit Subway Bridge has been approved by the Art Commission, and authority has been given by the Board of Estimate and the Board of Aldermen for a contract for the removal of the superstructure of this bridge to the masonry of the University Heights Bridge, and for the construction of a new bridge over the Ship Canal, the result being that we shall have excellent bridges in both these locations.

It has been proposed by citizens interested in celebrating the three hundredth anniversary of the discovery of the Hudson river that, instead of building a water gate or a triumphal arch or other equally beautiful but equally useless monument, a memorial bridge should be erected over Spuyten Duyvil creek, near the Hudson river, in honor of the famous navigator Hendrik Hudson, who, in the year 1609, sailed up the river which bears his name.

The ground is high on both sides of the creek, and a bridge on this site would be similar in usefulness and artistic importance to the Washington Bridge. The Riverside Drive and Boulevard Lafayette, extended, lead almost directly to the southern approach, and the bridge would form an extension of these boulevards on to the high and picturesque ground east of the Hudson and north of the Harlem.

A beautiful design for a memorial bridge has been made by a well-known firm of consulting engineers, and there would seem

to be no reason why the Department of Bridges should not be able to construct a creditable work of art in this location, and one which will at the same time accord a useful and extremely necessary connection between the westerly sections of the two boroughs. If the bridge is to be ready by 1909 there is very little time to be lost in preparing for its construction.

Existing bridges over the Harlem river have been maintained during the year 1904 with vigilance and economy, and are in their usual good condition. The question of the proper protection by paint of these metal structures is a serious one, and owing to the limited appropriation for repairs, a question always difficult to meet. It does not appear to be good economy to allow structures which have cost from one-half million to two million dollars each, and which should last indefinitely, to deteriorate for want of an annual expenditure of less than one-half of one per cent. of their cost.

Borough of The Bronx.

Pelham Bridge Over Eastchester Bay—The contract for the foundations and piers of this bridge was let on November 12, 1903, but the work on it could not begin until April, 1904, on account of the severe winter weather. Since that time it has been pushed with considerable vigor. The foundations of one abutment, two intermediate piers and of one draw span pier are now practically finished. The other four foundations and all the masonry above low water cannot be built until next spring. The contract for the concrete-steel arches and the steel drawspans will be ready for letting at that time. It now appears as if an additional appropriation of about $100,000 must be obtained in order to complete this bridge. The work covered by the present contract is now practically half done.

Westchester Avenue Bridge Over Bronx River—The permanent bridge over the Bronx river at Westchester avenue was finished during the first quarter of this year, but is not yet open for traffic because the grade of Westchester avenue is not yet completed, and the temporary bridge about one hundred yards down stream is still in use. The regulating and grading of Westchester avenue is under contract by the Bureau of Highways, and as soon as the avenue is completed the bridge will be opened to traffic.

The rapid growth of the borough east of the Bronx river has resulted in the opening of new arteries of travel; one of the most

important is the extension of Tremont avenue across Westchester creek, at the site of the present Unionport Bridge, an old narrow structure that will be inadequate for traffic coming through the new thoroughfares. Studies are being made for a modern bridge at this crossing, and application will be made early in the year for an appropriation necessary to rebuild this bridge.

Eastchester Bridge Over Hutchinson River—This structure is old and nearly worn out, but as traffic on the Boston Post road has been light the bridge has answered the purpose until now. With the improvement of the old thoroughfare it is likely that the travel will increase, and the present span should be torn down and replaced, which I think can be done at comparatively trifling cost.

All of the bridges in the borough have been more or less extensively repaired. The superstructures of the Kingsbridge and of Farmers' Bridge over Spuyten Duyvil creek have been entirely rebuilt since the first of the year. Most of the other structures have been replanked and are now in fair condition. The principal requirements in the way of maintenance during the coming year will be the relaying of the asphalt pavement on the City Island Bridge and the strengthening or renewal of the foundation of Unionport Bridge and the strenghtening of the arches of the old Pelham Bridge.

Borough of Queens.

The bridge over Newtown creek at Vernon avenue was contracted for December 9, 1901, at an estimated cost of $547,046. On January 1, 1904, the bridge was 41 per cent. completed. On December 1, this year, it was 78 per cent. completed, 37 per cent. having been finished during the year. The approximate date of completion is July 1, 1905.

The bridge over Flushing creek, from Jackson avenue, Newtown, to Broadway, Flushing, now in course of construction, was contracted for April 15, 1904, at an estimated cost of $257,844. The temporary bridge to be used during the construction of the new bridge was completed and opened for traffic September 27, 1904, and the superstructure of the old bridge was removed. The date of the completion of the new bridge, as per contract, is October 1, 1905, but the delay in securing the right of way will probably extend this to the beginning of the year 1906.

The bridge over Newtown creek at Metropolitan avenue, con-

necting the boroughs of Brooklyn and Queens, is a fixed wooden trestle. The old bridge has been removed and the work of reconstruction is now going on, at an estimated cost of $2,000, which will be charged to maintenance appropriation.

The creek under this bridge is not navigable, and there is no good reason why the bridge should be maintained. Efforts will be made during the coming year to have a bulkhead constructed at this point, and Metropolitan avenue carried over the same on earth fill, which will materially improve Metropolitan avenue and the surrounding district.

In this borough the City should acquire land at the northeast corner of Vernon avenue and Fourth street, Long Island City, for the purpose of forming a plaza and an adequate entrance to Vernon Avenue Bridge.

The Greenpoint Avenue Bridge and the Meeker Avenue Bridge should both be raised so as to allow a clear headway of 24 feet at mean high water (same height as at the Vernon Avenue Bridge now building), and by means of viaducts on the Queens side of the creek in both cases, abolish the dangerous grade crossings of the Long Island Railroad, the tracks of which cross the streets leading to these bridges a few hundred feet from the creek. At an early date, probably not next year, an effort should be made to eliminate the centre piers of the draw bridges on Newtown creek. These piers materially restrict the waterway and the convenience of operating floating traffic on the creek. With bascule or some other bridges without centre piers, and with clear headway under them of 24 feet, the traffic on the creek would be materially benefited and the necessity for opening the bridges would be materially lessened by these changes.

The Borden Avenue Bridge, over a branch of Newtown creek, should be rebuilt next year, as should the bridge over Alley creek, between Bayside and Douglaston.

Boroughs of Brooklyn and Richmond.

Funds for the four bridges over the Gowanus canal were made available in February. The work on three of these bridges, Hamilton avenue, Third street and Union street, was started promptly and promises to be completed in March next. The fourth one of these bridges, Ninth Street Bridge, owing to difficulties in obtaining the right of way for a temporary structure, cannot be

started until the Union Street Bridge is finished, but will be finished, it is thought, during the summer of 1905.

These new bridges, with greater facilities for both land and water travel, will greatly increase the usefulness and cleanliness of the canal and the usefulness of the streets crossing it.

The Princess Bay Bridge, which is a long timber trestle, with an iron draw near the middle, requires a great deal of attention to keep the timber work in repair. It is proposed to replace the long trestle by an earth fill, which will make a substantial approach to the draw span and materially lessen the cost of maintenance.

It is proposed to erect the old Ninth Street Bridge, crossing Gowanus canal, across the Lemon creek, near Tottenville, S. I., and thus replace a structure which is old and inconvenient.

The report of the Chief Engineer of the Department of Bridges is published herewith.

Respectfully submitted,

GEO. E. BEST,
Commissioner of Bridges.

Statement of Appropriations and Expenditures for the Years 1902, 1903 *and* 1904

	Salaries and General Administration.	Supplies and Contingencies.	Maintenance and Repairs.				Totals.
			Harlem River.	Borough of The Bronx.	Boroughs of Brooklyn and Richmond.	Newtown Creek and Borough of Queens.	
Appropriations, 1902	$52,972 00	$2,170 16	$180,965 44	$30,228 15	$63,006 50	$66,801 13	$397,143 38
Expenditures, 1902	53,971 61	2,170 16	180,591 67	30,227 75	62,685 02	65,751 42	395,397 63
Balance, 1902	39	....	373 77	40	321 48	1,049 71	1.745 75
Appropriations, 1903	61,350 00	4,394 92	182,664 90	31,235 38	59.546 86	74,147 81	413,339 87
Expenditures, 1903	57,116 26	3,894 92	181,664 90	29,625 35	53.139 56	73,676 82	399,117 81
Balance, 1903	4,233 74	500 00	1,000 00	1,610 03	6,407 30	470 99	14,222 06
Appropriations, 1904	51,204 15	2,869 27	203,979 20	28,298 00	62,681 50	73,956 26	422,988 38
Expenditures, 1904	....	......	....	......	....	....	......
Balance, 1904	......	....	....	....	......	....	......

For the years 1902 and 1903 the actual expenditures are as stated.
For the year 1904 the actual expenditures and outstanding obligations will about equal each other.
The unexpended balances for the years 1902 and 1903 have been turned over to the Department of Finance.

REPORT OF THE CHIEF ENGINEER.

DECEMBER 31, 1904.

Hon. GEORGE E. BEST,
Commissioner of Bridges:

DEAR SIR—The last general report of the Chief Engineer of the Department of Bridges was made by Mr. Samuel R. Probasco and dated November 30, 1901. Mr. Leffert L. Buck became Chief Engineer of the Department in January, 1902; he resigned on May 1st of the same year to become Consulting Engineer of the Williamsburgh Bridge, and his successor was not appointed until January 7, 1904.

The work of the Department is outlined in detail by the Engineers in charge of the various divisions in their reports presented herewith, and it only remains to refer in general terms to some of the most important engineering work undertaken, accomplished, in progress or projected by the Department.

The Greater New York Charter placed the construction, maintenance and control of all the bridges in the city, over navigable streams or connecting two boroughs, in the hands of the Commissioner of Bridges, excepting only the Williamsburgh Bridge, which was planned and had its major items of construction contracted for by a special commission created by chapter 789 of the Laws of 1895. On January 1, 1902, this bridge was also placed under the control of the Commissioner of Bridges by amendment to the Charter.

Some important items in connection with work executed or in progress are given in the following chronological statement:

Brooklyn Bridge.

Bridge railway leased to the Brooklyn elevated railroad companies	June 23, 1898
Trolley cars commenced running over the bridge on the roadways	Feb. 16, 1898
Four additional trolley car loops put in service on the Manhattan side	Nov. 15, 1903
Plans for extension of the Manhattan Terminal presented to the Board of Estimate and Apportionment	Apr. 5, 1904
First application for temporary extension of railway tracks and platforms over Park row and Centre street, made to the Board of Estimate and Apportionment	Feb. 17, 1904

Second application for temporary extension of railway tracks and platforms over Park row and Centre street, made to the Board of Estimate and Apportionment	Dec. 6, 1904

Williamsburgh Bridge.

South roadway opened to the public	Dec. 19, 1903
Footwalk opened to the public	May 7, 1904
North roadway opened to the public	May 29, 1904
Traffic agreement executed for the operation of surface cars over the bridge	May 21, 1904
Brooklyn surface cars commenced running over the bridge to temporary terminal in Manhattan	Nov. 3, 1904

Blackwell's Island Bridge.

Bridge authorized by City authorities	Nov. 15, 1900
Contract for foundations and piers awarded	June 27, 1901
Foundations and piers completed	June 10, 1904
Contract executed for steel superstructure	Nov. 20, 1903
Contract for power-houses and elevator shafts awarded	Dec. 31, 1903

Manhattan Bridge.

Bridge authorized by City authorities	Jan. 8, 1900
Contract for Brooklyn tower foundation dated	May 1, 1904
Brooklyn tower foundation fully completed	Aug. 5, 1904
Contract for Manhattan tower foundation dated	Dec. 22, 1902
Manhattan tower foundation fully completed	Aug. 20, 1904
Plans for proposed substituted eye-bar bridge approved by the Art Commission	Mar. 10, 1903
Plans for proposed eye-bar bridge rejected	June 15, 1904
Revised plans for original type of wire cable bridge presented to the Art Commission	June 23, 1904
Revised plans for wire cable bridge approved by Art Commission	Sept. 15, 1904
Plans for the bridge finally approved by United States Government engineers	Jan. 5, 1905
Bids for anchorages opened	Dec. 22, 1904

Harlem River Bridges.

Contract for One Hundred and Forty-fifth Street Bridge awarded	Feb. 4, 1898
Work stopped on erection of draw span pending construction of subway tunnel	Feb. 1, 1902
Work of erection of draw span resumed after partial completion of subway tunnel	July 1, 1904
Contract for central pier of University Heights Bridge awarded	Nov. 18, 1903

Central pier of University Heights Bridge completed	Sept.	1, 1904
Ship Canal Bridge opened to the public	Jan.	1, 1895
Terms of contract for reconstruction and removal of Ship Canal Bridge agreed upon	Dec.	, 1904
Contract executed for construction of Southern Boulevard approach to the Willis Avenue Bridge	June	23, 1904

Bridges in the Borough of The Bronx.

Contract executed for foundations, piers and abutments of Pelham Bridge, over Eastchester Bay	Dec.	3, 1903
Contract executed for Westchester avenue Bridge, over the Bronx river, awarded	Sept.	5, 1901
Westchester Avenue Bridge, over the Bronx river, completed	May	3, 1904

Bridges in the Borough of Queens.

Contract awarded for Vernon Avenue Bridge, over Newtown creek	Dec.	9, 1901
Contract awarded for bascule bridge over Flushing creek	Apr.	15, 1904
Temporary bridge over Flushing creek opened to public	Sept.	20, 1904

Bridges in Boroughs of Brooklyn and Richmond.

Contract executed for bascule bridge at Hamilton avenue	Dec.	31, 1903
Contract executed for bascule bridges at Union street, Third street and Ninth street	Dec.	31, 1903
Temporary bridge at Hamilton avenue opened to public	Apr.	5, 1904

THE BROOKLYN BRIDGE AND ITS RAILROAD CONNECTIONS IN MANHATTAN.

In 1886 the railway travel over the Brooklyn Bridge had become so great as to result in serious overcrowding of the platforms and cars of the Bridge railway. An attempt was made to extend the platforms and tracks over Park row and Centre street, but the opposition of the property-owners on Park row and Tryon row resulted in an injunction restraining this extension and the passage of a law forbidding such construction.

Ten years of study and effort resulted in the approval and construction of the present bridge terminals. As an interesting feature of the study given the problem, the following table shows an estimate made in 1889 of the probable daily travel over the Bridge railways, while the actual number of passengers carried

in one day in the corresponding years to date is given in a separate column:

Year.	Estimated Daily Travel.	Actual Travel in One Day.	Remarks.
1890........	169,000	122,298	Bridge Railway Only.
1895........	202,000	133,077	Bridge Railway Only.
1900...	225,000	275,823	Including Trolley Lines.
1905........	243,000	*356,976	Including Trolley Lines.
1910........	259,000	....	
1915........	272,000	.... ..	
1920........	284,000	....	
1925...	294,000	....	
1930	304,000	. ....	
1935...	313,000	....	

*In 1904.

The new stations materially increased the efficiency of the Bridge railway, but the travel quite kept pace with the increased facilities. The operation of surface cars over the Bridge and the leasing of the Bridge railway to the elevated railways of Brooklyn was a great boon to the people crossing the Bridge; as the toll was dispensed with for passengers on through cars desiring to cross the Bridge, there resulted an actual saving to these passengers of five cents for each round trip, equivalent to-day to a dividend of about 14 per cent. on the cost of the Bridge, made directly to the people who ride on the cars.

Chapter 712 of the Laws of 1901 resulted at once in the appointment of a board of engineers, who advised the construction of an elevated railway through Centre street, connecting the elevated railway tracks of the Brooklyn Bridge with those to be laid on the Williamsburg Bridge, which would permit the collection and distribution of passengers beyond the Bridge terminals and relieve the congestion at these points.

In 1903 the Corporation Counsel held that the Law of 1901 did not permit the construction of such a railway or of any structure which could not fairly be considered an extension or enlargement of the westerly terminal of the Brooklyn Bridge, and

this opinion was substantially confirmed by the present Corporation Counsel early in 1904. The Law of 1901 did, however, repeal the legislation prohibiting the crossing of Park row and Centre street.

Plans were made in 1903 for the enlargement of the Manhattan terminal of the Brooklyn Bridge, to include a large building with a gigantic campanile on Centre street to the north of the Bridge. It was intended to extend the Bridge railway tracks through this station and over the Manhattan railway tracks in Park row and the Bowery as a second story to the Manhattan railway structure, and to provide for moving trains by this route to the Manhattan terminal of the Williamsburgh Bridge. Serious objection had developed to the construction of an elevated railway through Centre street and in front of the public buildings on that street, and it also appeared that the Manhattan Railway Company desired to use a second story to its structure for its own purposes if built, and that it would be practically impossible to operate two lines of railway over the same structure, one by a private corporation and the other by the City.

It required no special inspiration to see that the actual crowding of the Manhattan terminal of the Brooklyn Bridge and the probable crowding of the same terminal of the Williamsburgh Bridge, when opened, result from inability to handle cars rapidly at these termini, and that if these bridges, and the Manhattan Bridge when completed, could be connected by an unobstructed railway, over which trains could run, collecting and distributing passengers en route, the terminals would be obliterated and the crushing crowds at the terminal stations would cease to exist. Every important effort for bridge relief since 1900, whether by underground or elevated railway, has been based on this theory, and no plan which fails to provide for an interchange of trains and cars between these bridges will succeed or deserve success.

Early in 1904 the Board of Estimate and Apportionment approved the location of an extension of the westerly terminal of the Brooklyn Bridge and of the acquisition of property therefor on the easterly side of Centre street, from Tryon row to Pearl street, on which a station building could be built, the upper stories of which could be used for office purposes and thus more fully justify the large expenditure involved. Such a building would house-in the tracks and platforms of the Bridge railways, and should be a creditable addition to the architecture of the easterly side of City Hall square.

The construction of this Centre street terminal station will consume at least two years, and to cover this interval and provide almost immediate relief for the excessive crowding at the present terminal, the plan for the Centre street improvement contemplated the extension of the present tracks and platforms over Centre street on to the site of the old Hall of Records, now used as an entrance and exit plaza for the Subway. This site had been for nearly three years, during the construction of the Subway, an unsightly rubbishy spot, blocking the entranceway to the Bridge almost completely with timber, building material and dirt. It was hoped that the reasonable and cleanly occupancy of a small portion of this space might be conceded to the greater safety and convenience of people crossing the Bridge for the space of two years, until the Centre street station could be completed, when it must, perforce, be abandoned and the temporary structure removed. The first application for the definite authorization of this extension of the Bridge tracks was made to the Board of Estimate and Apportionment on May 25, 1904, and a second application for a more restricted use of the space was made on December 6. The Board of Estimate and Apportionment promptly referred the matter in both instances to the Park Department. In neither instance was any action taken, and it now appears evident that no action will be taken, but the applications will be allowed to die from inattention.

It developed after the second application was made that certain interests had united to secure an injunction, should official approval of this plan be secured. During the pendency of these applications no genuine effort was made by the opponents of the plan to examine the situation thoroughly or to understand the exigency or emergency which demanded the temporary extension of the platform and tracks. On the official side there was the easy and often effective method of mere stolid inaction of mere unreasoning obstruction, while the threats of injunction were intensified by the knowledge that the improvement could not be made without benefiting certain corporate interests in Brooklyn against which a bitter war was being waged at the time.

In the face, therefore, of impending defeat, I deem it advisable to abandon the effort to give the public the relief which the crossing of Centre street certainly promised, and to try to get a small percentage of the loaf if the whole loaf cannot be had, and to make application for such an extension of the tracks and plat-

forms as it is possible to get, confining the improvement wholly to the east side of Centre street, where it is still possible to secure better facilities for handling the Bridge trains, and, by enlarging the platforms, relieve the crowding on them to some extent. The original plans would have bridged over neatly the time necessary for the construction of the new station building; would have permitted the handling of more and longer trains on the Bridge with very little excessive crowding on the platforms, and would have permitted all the Brooklyn Elevated Railroad trains to run into and out of the Manhattan station at all times, thus avoiding the delay and inconvenience of changing cars in Brooklyn, and effecting a very material betterment of the present conditions, which even with the improvements now possible must grow worse and worse until the larger Centre street station can be completed some two years hence.

This extension of tracks westerly of the present station is one which the late Mr. C. C. Martin urged and labored for incessantly during the last years of his useful life for the Bridge. He believed that what we shall now attempt to secure would improve conditions materially, while the full extension, which, but for the opposition developed, would now have been in operation, was more than he had dared hope for, because of the then obstruction of the old Hall of Records.

From the Centre street station at Pearl street a four-track elevated railway was projected through private property to Baxter street, following this street, which it was proposed to widen on the west side to 90 feet in width, and cutting through private property again near Hester street, pass into Delancey street extended, and follow this street to the Williamsburgh Bridge Plaza at Norfolk street.

The land taken would, together with Baxter street and Delancey street, furnish a wide vehicular thoroughfare as well as an easy route for an elevated railway route between the two bridges. Over this elevated railway, trains from the Manhattan and Williamsburgh bridges could pass to a City Hall station, which will be absolutely necessary while the Brooklyn Bridge is out of service for the renewal of its superstructure. The contract by the City for the purchase of the charter of the East River Bridge Company's No. 1 Bridge requires that the City shall build and maintain two tracks over the Williamsburgh Bridge for the exclusive use of elevated railway trains. Delancey street was

widened with the understanding that it should have an elevated railway structure built in it, and although at some future time subways may be constructed across the East river connecting these three bridges in Manhattan, the construction of an elevated railway to connect these bridges is essential and imperative for the immediate relief of the congestion and inconvenience certain to result at all the terminals and until in the fullness of time some other lines of intercommunication have been developed.

It was realized that this connecting railway could only be built through the powers of the Rapid Transit Commission, that the powers of the Department of Bridges, even under the Law of 1901, must terminate at the Brooklyn Bridge with the construction of the Centre street station, and it was determined to push the work on this station as rapidly as possible, to permit the relief to the Bridge crush, and leave the question of further extension to the future.

THE WILLIAMSBURGH BRIDGE.

While Brooklyn trolley cars ran over the Williamsburgh Bridge on November 3, 1904, it was necessary to confine the handling of these cars in Manhattan to a temporary terminal, at which it is impossible to handle more than half the number of cars which can and should be run over one pair of tracks on that bridge. The widening of Delancey street as a street opening took from the Department of Bridges the control which it formerly had over the plaza space west of the actual end of the bridge at Clinton street, and made it impossible to construct an adequate and proper terminal for trolley cars at Clinton and Delancey streets without securing special legislation therefor, and made it impossible to creditably operate any elevated railway trains over this bridge without the action of the Rapid Transit Commission.

Early in 1904 plans and specifications for a terminal station over the Manhattan end of this bridge were prepared, and the construction of such a terminal is anticipated in the traffic agreement with the surface railways, dated May 21, 1904. The powers of the Commissioner are ample and there were sufficient funds for the construction of such a station, which could have been completed in a short time, and in which trolley and elevated passengers would at once have found abundant accommodation. Nothing but your disinclination to build a station in other respects unworthy of the bridge and your hope that action would speedily

be taken to furnish another and better opportunity to secure this public convenience prevented the execution of this work. The inability to build a station or any track extension at this end of the bridge has deferred the construction of an adequate terminal and occasioned inconvenience and hindrance to the development of the traffic over the bridge, which have now lasted nearly a year and which cannot now be materially relieved for years to come.

The much-abused traffic agreement for the operation of surface cars over the Williamsburgh Bridge has been sustained by the trial court in proceedings seeking to enjoin its execution. The cars which have run on the south tracks since November 3rd last have carried a great many passengers. Seven lines of Brooklyn cars, besides the local cars, are run over the bridge; the maximum number of cars run from Manhattan to Brooklyn in one hour has been about 120, or about half as many as the average number during rush hours on the Brooklyn Bridge, and the cars are all fully loaded during the rush hours. While these tracks have a present capacity less than one-half of the two tracks on the Brooklyn Bridge, they would with a complete terminal have a capacity greatly exceeding those of the Brooklyn Bridge. The cars of the New York City Railway Company will run over the north pair of tracks as soon as these are completed, and will carry a great many people conveniently and comfortably from Brooklyn across town in Manhattan. Ultimately, and not many months hence, three crosstown lines, a downtown line and cars from Third and Fourth avenues, in Manhattan, will run over these tracks to the plaza in Brooklyn.

The wide carriageways and footwalks on the Bridge are fully justified in operation. The number of teams crossing this bridge will soon, I believe, exceed that crossing the Brooklyn Bridge, and even now there seems to be a lessening of traffic of this kind over the older bridge. The footwalks are extensively used, especially during the milder weather, when there are often six to ten thousand people on the bridge at one time. The expected exodus from the East Side to East New York has set in, and all that is required to make this bridge as valuable as it should be to Manhattan and Brooklyn is a material betterment of its railway capacity, which is very far from reaching its normal proportions.

The studies of the Department of Bridges and of the Rapid Transit Commission as to connections for or with the bridges over the East river have been devoted almost exclusively to

elevated or train service. It should be remembered that the number of great bridges over the river can never be very large, the excessive cost and the vast areas of real estate taken from private utilities and from the assessment rolls dictate that the number of such bridges shall not be excessive. Tunnels can be built quicker and cheaper than bridges and are the normal agencies for the passage of subways across the river. We cannot, however, put our highways in tunnels, and the great bridges should be used to their maximum capacity for highway purposes. They should provide for the safe and expeditious transit of vehicles and of surface cars. More people traveled in surface cars in New York City last year than in the elevated railway cars, and even with the multiplication of subways the surface cars must still be used, certainly for many years, for transit over the East river, and these cars can be run most easily and most conveniently over the bridges. The discharge of passengers from the surface cars at the termini of the bridges is quite as objectionable as from the elevated railways, and careful consideration should be given to a wise distribution and collection of all railway passengers over the bridges. The Boston Subway was built exclusively for the use of surface cars, and the old Hudson River Tunnel is being completed for the same service. There is no valid reason why the surface cars over all the bridges from Brooklyn and Queens should not pass into subways in Manhattan and thus secure a wider, safer and more expeditious distribution and collection of passengers for the surface cars.

The basement of the Centre Street Station could be used for an intermediate collecting and distributing station for Brooklyn surface cars, safer and more convenient than the present loop terminal; and an underground station could be easily built at the Manhattan terminal of the Williamsburgh Bridge which would conveniently accommodate and shelter the passengers from the surface cars and at the same time provide for the extension of the surface lines across or up or down town in Manhattan, as is now proposed for the surface cars through the old Hudson River Tunnel from Jersey City.

BLACKWELL'S ISLAND BRIDGE.

The plans on which the contracts for the superstructure of this bridge were let in 1903 provided for a bridge only 86 feet wide, with a relatively narrow carriageway, and for only two

elevated railway tracks, with footwalks on the upper deck, requiring a long and steep ramp or stairways to reach them. No considerable amount of work had, in January, 1904, been done on the detail plans, which are to be made by the contractor. A careful examination of the plans was made early in the year and the following report from the Consulting Engineer will give the general result of the examination then made:

"April 9, 1904.

"*Mr.* O. F. Nichols,
"*Chief Engineer, Department of Bridges:*

"Dear Sir—Regarding the contract design for the superstructure of "the Blackwell's Island Bridge and the conditions bearing on necessary "or desired modifications of the same, I beg leave to report as follows:

"The original design was for a cantilever bridge, with the usual "arrangement of cantilever arms connected by suspended spans. The width "of bridge was 93 feet centre to centre of trusses and 120 feet over all.

"In January of 1902 this design was rejected by the then Commis- "sioner of Bridges and a new design substituted.

"The substitute design, after being submitted to a board of three "engineers for review of certain features and undergoing some material "modification, was advertised for letting on September 24, 1903. The "single bid secured at the first letting was rejected and the contract "readvertised. On the second letting the contract was awarded to the "Pennsylvania Steel Company, November 7, 1903.

"The contract design is for a cantilever bridge 60 feet wide centre to "centre of trusses and 86 feet wide over all. The arrangement of spans "eliminates the suspended spans, the cantilever arms extending until they "meet, and are connected by rockers capable of transferring shear either "way from one cantilever arm to the other, but not capable of transferring "bending.

"The chief points of difference between the original and contract "designs are the width and arrangement of spans.

"While I believe that, as a result of these differences, the original "design is distinctly better in the features of rigidity, capacity, convenience, "economy and appearance, the original width and span arrangement cannot "be restored without securing reversal of action taken by duly vested "municipal authorities, and by making radical modifications in the con- "tract, both of which, I believe, would lead to indefinite, but certainly "prolonged delay in the further prosecution of the work.

"While the contract design is a material departure from established "practice in cantilever bridge construction, it cannot be demonstrated by "the positive evidence of experience or mathematical calculation that it "will be so lacking in stability as to impair its safety or usefulness.

"The deflections—both vertical and horizontal—in the contract design "will be materially greater than in the original design, but the great "weight of the structure and the connection of the meeting cantilever "arms will probably suffice to keep these deflections from causing serious

"vibration, provided an adequate lateral system, which is lacking in the "contract design, be added.

"Were the situation such that it would be proper to take action on "the relative merits of the two designs as engineering and economical "propositions alone, I would recommend the adoption of the original "design in all essential features.

"But in view of the facts, that the City has been fully committed to "the contract design; that the defects of this design can, without going "outside of the contract or the authority of the Department of Bridges, "be so far remedied as to prevent it from being unsafe or seriously "deficient; that the paramount consideration is the promptest possible "completion of this work, and not the indulgence of personal ambitions "and prejudices, nor, indeed, at this time, the betterment of the design "from engineering or economical standpoints, I recommend that no effort "be made to alter the contract design as to width and arrangement of "spans.

"However, with these main features unaltered, there are still several "changes in structural arrangement and details which have been already "made and which must be made in order to secure a proper amount of "rigidity and to avoid irrational construction.

"The contract plans for this work cover but little more than the stress "diagrams and general arrangement. The few details that were furnished "cannot generally be followed and were very materially changed before "January 1, 1904.

"Under the contract the development of all detail plans, as well as "shop drawings, devolves on the contractors, the same to be approved by "the Commissioner of Bridges.

"It is difficult by this arrangement to arrive at results mutually satis-"factory to the contractors and the City without consumption of much "time, and it is quite impossible to determine what the actual cost of the "bridge will be.

"All the controlling details of the design should properly have been "developed before the contract was let, for, in such an unusual design "as this, it is impossible, without very full treatment of details, to properly "prepare the contract and specifications.

"To first let the contract and then prepare the plans is proceeding "backwards. While the execution of the contract under such conditions "may appear to be an advance in the execution of the work it really is not. "It is merely transposing the preparation of the plans and surrounding it "with restrictions and difficulties that prevent prompt action and impair "the character of the results.

"Letting a contract without the previous preparation of such plans as "will fix all essential features of the design is warranted only when the "nature of the work is so well known that such plans are unnecessary.

"The contractors are now preparing the detail plans required and have "submitted some of these for examination and approval. Although it is "evident that material modifications will be required in a number of these "details, enough of the plans have not yet been received from the con-"tractors to enable us to pass on the governing features.

"As thus far developed by consideration of the contract plans and "detail plans submitted, the following modifications in the plans appear "necessary or advisable:

"(1) There should be floor beams and brackets in the lower floor "system at all panel points. This was the arrangement embodied in the "contract plans, but was afterwards changed at the request of the con- "tractors on account of the difficulty in getting good floor-beam connec- "tions at the main panel points, and authority was given to have floor "beams only at the sub-panel points. This requires in some places 80-foot "stringer spans, which will give an extremely heavy and unduly elastic "floor. This is unnecessary, as it is perfectly practicable to provide "proper floor-beam connections at the main panel points without having "to resort to seriously difficult details.

"Not only will it give a stiffer and more economical floor to have the "floor beams at every panel point, but it will add materially to the lateral "stiffness of the bridge, which should be increased in every way prac- "ticable.

"(2) There should be a top lateral system throughout the entire length "of the bridge in the planes of the top chords, with straight across struts "holding the top chord sub-panel points laterally.

"In the contract design there is no top lateral system, and the top "chord sub-panel points were originally not even supported vertically. "However, on account of the natural insistence of the contractors, the "sub-verticals were allowed to be extended to the top chords.

"Without an adequate top lateral system there would be unquestionably "a formidable lack of rigidity in the structure.

"Under certain conditions of loading the top chords at the centre of "the river spans will be in compression, and, although throughout the "greater part of the bridge the top chords will always be in tension, the "top lateral system is necessary to prevent serious vibration.

"I doubt if a single case can be found of a cantilever bridge of even "moderate span and height of truss with no top lateral system.

"(3) There should be adequate sway bracing at the sub-panel points "to hold securely the points of intersection of the main diagonals, sub- "diagonals and sub-verticals.

"The omission of this bracing would render extremely insecure those "main diagonals subject to compression.

"(4) The longitudinal struts holding the main verticals near their "centres should be made discontinuous and horizontal, as is required to "meet the needs of the case, without the use of superfluous members, "interposed rather to make an imaginary improvement in a picture than "for any improvement in the appearance of the bridge itself.

"The discontinuous longitudinal struts as here proposed were shown "in the design approved by the Municipal Art Commission, the change "making them continuous being adopted later.

"The original arrangement is rational and will doubtless appear better "in the structure. The later arrangement is a mere waste of material "with no satisfactory return.

"(5) Lateral bracing should be provided in the planes of the top

"flanges of all track stringers. In the contract design only brace frames "are provided—one in the shorter spans and two in the longer spans. "This is contrary to universally recognized good practice, which requires "a continuous system of lateral bracing in plate girder or stringer spans "over 20 feet in length.

"In conclusion, I wish to further emphasize the necessity of so bracing "all parts of the structure, both laterally and vertically, that movement "and vibration, either local or general, will be as much reduced as possible. "The great length of cantilever arms as compared with depth of trusses "and width of bridge makes considerable movement unavoidable. If the "bracing omitted in the contract design and herein proposed is not pro- "vided, the amount of movement will, I believe, seriously impair the "strength of the bridge. If it is provided there are no grounds for main- "taining that the bridge will not have adequate stiffness.

"Yours truly,

"R. S. BUCK,

"*Consulting Engineer.*"

All of the recommendations of the above report were adopted, and a supplementary agreement was made with the contractors, by which it was made possible to put two additional railway tracks on the bridge if it shall be found necessary or desirable to do so. The bridge would then have the same railway capacity as the Manhattan Bridge, with eight tracks, four for trolley and four for elevated railway service.

Contracts for the approaches to this bridge will, it is hoped, be let during the year 1905, so that they may be completed as soon as possible, for it appears to be necessary to have the approaches to these large bridges actually completed before the questions of connections with them can be considered in a serious manner by the City authorities or the railways.

This bridge seems to be unfortunately located for connection with other lines of city travel, and to a large extent its connections must be left to the future development of the Borough of Queens, or to accident or caprice which may lead or drive traffic over it. It should be ready for use during the year 1907, and this date should be held in mind, to the end that the bridge may be advantageously used when completed. It will not answer merely to connect Second and Third avenues, in Manhattan, with the old Long Island City, whose future is secure because of its proximity to Manhattan, and which will soon be hedged in on the east by one of the largest and busiest railroad yards in the world. This bridge should afford safe and convenient connection between the great area of the Borough of Queens far beyond this railroad

yard and the West Side, as well as the East Side, and the downtown districts of Manhattan.

MANHATTAN BRIDGE.

It is especially unfortunate that this important bridge, destined to be the most used of any of the great bridges over the East river, should be so hindered and delayed in construction. It would but traverse ground already fully covered in your communications to the Mayor, the Board of Estimate and Apportionment, the Art Commission and to various civic bodies, to recount the story of the various hindrances and delays which have occurred.

Briefly, the Department has simply returned to the type of bridge anticipated in the beginning and approved by the Board of Public Improvements and the Board of Aldermen in 1899, and by the Mayor early in 1900, and to methods of construction which have been found most successful in the work of the Department, in which the City dictates not only the type of the structure, but the details which must be followed by the contractors in the construction. Only in this way can we tell with any close degree of approximation what the structure will be or what it will cost when completed.

Here again the problem of terminal connections looms up in almost appalling proportions. The bridge begins almost precipitately at the Bowery and terminates abruptly at the commencement of a long street, over no portion of which this Department has any control, and in connection with which the experience at Delancey street will, in all probability, be repeated and intensified. The problems of connections here are only more interesting because more difficult, but when they must be studied and settled by three or four separate and independent bodies, with different ideas and aims, delay and nothing but delay can possibly result. I should not, indeed, be at all surprised if the bridge would be completed and opened to the public long before the questions of transit connections are fully determined.

BRIDGES OVER THE HARLEM RIVER.

The completion of the Southern Boulevard approach to the Willis Avenue Bridge, which is expected during the year 1905, will aid materially in the development of the southerly portion of the Borough of The Bronx. This work has, in common with all the other work of the Department, and especially that involving excavation or masonry, been seriously delayed by the severity of the early winter.

The Madison Avenue Bridge is one of the oldest of the existing drawbridges over the Harlem river; it was too narrow when built and the approaches are steep and inconvenient. Plans are being made for a new bridge, on which it is hoped to ask bids within a few months.

The necessity of providing good temporary bridges for use during the reconstruction of the old drawbridges materially increases the cost and time of construction, and the inconvenience of the public in the interval.

The bridge across the Harlem river, from One Hundred and Forty-fifth street, in Manhattan, to One Hundred and Forty-ninth street, in The Bronx, has been delayed more than two years, pending the partial completion of the subway tunnel under the river, which is constructed along and too close to the southerly side of the Bronx approach and directly under the fender pier, which must support one-half of the drawspan during construction. The bridge is much needed and will probably be opened to traffic about July 1 next.

The centre pier and fender for the University Heights Bridge across the Harlem, from Two Hundred and Seventh street, in Manhattan, to One Hundred and Eighty-fourth street, in The Bronx, is completed, and a contract will soon be let for the completion of the bridge, the plans for which have been approved by the Art Commission. The work of removing the grade crossing at Fordham Landing Station on the New York Central and Hudson River Railroad will be prosecuted in connection with the work on the bridge, and the new railroad station will be located on a span over the railroad tracks, which forms an approach to the bridge.

The bridge over the Ship Canal at Broadway is a fine structure, which was completed about ten years ago. The contract for the Rapid Transit Subway requires that the contractor shall carry the elevated railway on the subway route over this bridge, and the New York City Railway Company desires to extend its underground electric line over this bridge, while the New York Central and Hudson River Railroad Company wishes to lengthen out and alter the fixed span on the Bronx side, to permit the passage of its new four-track cut-off under the bridge. An agreement has been reached between the Subway Construction Company, the railroad companies above referred to and the Commissioner of Bridges, providing for the construction of a new bridge at this point to meet the several conditions imposed; the Subway Construction

Company agreeing to transfer the superstructure of the present bridge to the masonry of the University Heights Bridge, where it will serve as a useful and effective bridge. The plans for the new Ship Canal Bridge, prepared by the Engineers of the Rapid Transit Commission and approved by you, have now been approved by the Art Commission, and the steel work is being manufactured in the bridge shops.

BRIDGES IN THE BOROUGH OF THE BRONX.

It is hoped that the Westchester Avenue Bridge over the Bronx, which has been completed some months and is now waiting for the completion of the grading of Westchester avenue by the Bureau of Highways, can be opened within a few months. This is a retractile bridge of great width and with liberal head room over the water.

Work on the foundations for the piers and abutments of the Pelham Bridge over Eastchester Bay, in Pelham Bay Park, can doubtless be pushed to completion in the early summer, and it is hoped to contract soon for the superstructure of this bridge, which will be a series of reinforced concrete arches, with a channel span of the Bascule type.

The Unionport Bridge over the Eastchester creek, on the line of Tremont avenue, is old and in unsatisfactory condition. Plans are now being made for a new bridge, which should be contracted for during the year 1905.

The bridge over Hutchinson creek on the Boston road, which is old and in an unsatisfactory condition, will be replaced within a few months.

BRIDGES IN THE BOROUGHS OF BROOKLYN AND RICHMOND.

Three of the four Bascule bridges over the Gowanus Canal are nearing completion. The largest one, at Hamilton avenue, and the Union street bridge will probably be opened for traffic about March 1st. The Third Street Bridge will be completed about a month later, while the fourth Bascule bridge, at Ninth street, will be completed about August 1st. The indications are that the removal of all the centre piers in the canal and the widening of the waterways, which the completion of these bridges will effect, will result in a marked improvement in the efficiency of the canal, while the raising of the Hamilton Avenue Bridge will materially lessen the number of bridge openings at this important avenue.

The small swing bridge over Fresh Kills, in Richmond, is approached from both sides on long pile trestles. The planking on these trestles requires constant attention and frequent repairs, while the piles and timbers of the trestle have been in service several years. It is proposed to fill in about the piling of the trestles and change the approaches of this bridge to a macadam roadway on earth fill, which will require less attention and prove a great improvement to the district in which the bridge is located.

The bridge over Lemon creek, near Princess Bay, is an old timber bridge, which is too narrow and weak for this location and sadly in need of reconstruction. It is hoped that a contract for a new bridge at this point can be let within a few months; the present bridge, which is a curiosity, represents just the kind of bridge which should not exist in The City of New York, and will be replaced by a more modern and effective bridge.

BRIDGES IN THE BOROUGH OF QUEENS.

The removal of the centre piers and the increase in the waterways rendered possible thereby, as in case of the Bascule bridges over the Gowanus Canal, originated in the Department in the contract for the Vernon avenue high level bridge, which was let on December 9, 1901. This is a large wide bridge, carrying an important avenue over an important waterway. There has been much delay in the construction of this bridge, due partly to hindrance in getting possession of the right of way; it is now hoped that the bridge can be opened to the public early next summer.

At no distant day two or three other bridges over Newtown creek should be replaced by high-level bridges of similar type, with wide central waterways, facilitating the navigation and cleanliness of the creek, and permitting the abolition of the grade crossings of the Long Island Railroad, which are a hindrance to transit over the creek and a serious menace to human life.

The Borden Avenue Bridge over Dutch Kills should be rebuilt as soon as possible, and it is hoped that a contract can be let for this work within a few months.

The temporary bridge over Flushing creek was completed and the old bridge removed some months ago. There has been considerable delay in securing right of way for the construction of the new bridge, but it is expected that the work can be pushed with much vigor during next season.

The engineering staff of the Department is as follows:

O. F. Nichols, Chief Engineer;
R. S. Buck, Consulting Engineer; L. L. Buck, Consulting Engineer, Williamsburgh Bridge;
Alexander Johnson, Assistant Engineer, Assistant to Chief Engineer.

Brooklyn Bridge.

Archibald McLean, Engineer in Charge;
Samuel R. Probasco, Ass't Eng'r;
C. B. Martin, Consulting Electrical Engineer;
B. G. Lingerman, Draughtsman;
James Napier, Rodman.

Williamsburgh Bridge.

Kingsley L. Martin, Engineer in Charge;
Geo. S. G. Lewis, Ass't Eng'r;
Engar D. Knap, Ass't Eng'r;
F. V. Z. Lane, Inspector Masonry;
James Clark, Inspector Masonry;
O. M. Kelly, Assistant Engineer;
John A. Tilly, Assistant Engineer;
Bernard Carlin, Inspector Masonry;
Louis Krummel, Rodman.

Manhattan Bridge.

Holton D. Robinson, Engineer in Charge;
Leon S. Moisseiff, Ass't Eng'r;
Robert E. Hawley, Ass't Eng'r;
Clarence L. Carman, Draughtsman;
Guy Vroman, Draughtsman;
J. A. Knighton, Assistant Engineer;
Arthur I. Perry, Ass't Eng'r;
Alexis J. Malukoff, Draughtsman;
C. O. Cox, Draughtsman;
Timothy A. Haggerty, Inspector of Masonry.

Blackwell's Island Bridge.

John D. Wilkens, Engineer in Charge.
Oscar Erlandsen, Ass't Eng'r;
J. O. Eckersley, Assistant Engineer;
Ernest A. Fintel, Transitman;
R. C. Strachan, Assistant Engineer;
Lewis P. Brown, Draughtsman;
John McMurray, Insp'tor Masonry;
William J. Daly, Inspector Masonry.

Harlem River and Borough of Manhattan Bridges.

Martin Gay, Engineer in Charge;
Judd A. Lockwood, Ass't Eng'r;
George E. Jackson, Topographical Draughtsman;
J. F. Raymond, Leveler;
Joseph A. Kehoe, Rodman;
Wm. A. Carsey, Inspector Masonry;
Charles F. Dolan, Ass't Eng'r;
B. J. Walsh, Transitman;
Fred C. Willett, Leveler;
James A. Fitzgerald, Inspector Masonry;
Chas. J. Giblin, Inspector Masonry;
Ernest E. Krampff, Inspector Steel and Iron.

Borough of The Bronx Bridges.

John G. Theban, Engineer in Charge;
J. W. Balet, Assistant Engineer;
Peter J. Murphy, Transitman;
George Adams, Axeman;
David J. Shaw, Inspector Masonry;
Geo. H. Hefele, Ass't Eng'r;
Hugh F. Bresnan, Rodman;
Pat'k J. Dwyer, Inspector Masonry;
Wm. Maloney, Inspector Masonry.

Boroughs of Brooklyn and Richmond Bridges.

J. S. Langthorn, Engineer in Charge;
David E. Baxter, Draughtsman;
C. I. Crocker, Draughtsman;
A. W. Birmingham, Leveler;
Wm. F. Perry, Transitman;
Frank J. Lynch, Leveler;
William H. Fletcher, Axeman.

Borough of Queens Bridges.

Edward A. Byrne, Engineer in Charge;
E. B. Jennings, Assistant Engineer;
John A. Wallner, Axeman;
Thomas S. Griffin, Transitman;
Henry W. Harding, Transitman;
John Kelly, Axeman.

Main Office Draughting Room.

George R. Ferguson, Engineer in Charge;
Wm. F. King, Draughtsman;
M. Joachimson, Structural Draughtsman;
E. J. Carney, Transitman;
Joseph E. Palmer, Photographer;
Max Feldman, Bridge Draughtsman;
S. S. McGrath, Architectural Draughtsman;
F. F. Fuess, Transitman.

Surveying Corps.

Noah Cummings, Assistant Engineer in Charge of Surveys;
Edward P. Hermann, Transitman;
Norris P. Stockwell, Masonry Inspector;
James Lappen, Leveler;
H. L. Connell, Leveler;
E. D. McIlroy, Transitman;
Adrian La Forge, Transitman;
Moses H. Dreyfus, Toolman;
Nicholas Eberhard, Axeman.

Respectfully submitted,

O. F. NICHOLS,
Chief Engineer.

Bridges Over the East River.

No. 1—Brooklyn Bridge.

O. F. Nichols, Esq.,
Chief Engineer, Department of Bridges:

Dear Sir—I have the honor to submit the following report of the service of the Brooklyn Bridge for the year ending December 31, 1904:

As no annual reports were printed for 1902 and 1903, and the quarterly reports submitted were necessarily brief, containing only a summary of the volume of passenger and other traffic on the Bridge, therefore, included in this report is a brief historical account of the improvements in and additions to terminals facilities proposed, and those consummated since December 31, 1901. To maintain continuity of printed record, also included are detailed

EAST RIVER BRIDGE NO. I, BROOKLYN BRIDGE.

statements and tables of railway car, surface car, vehicular and other traffic on the Bridge for the years 1902, 1903 and 1904.

At the close of the year 1901 plans had been prepared for the extension of the terminal station in the Borough of Manhattan and an elevated railway structure in Centre street and Grand street connecting the Brooklyn and Williamsburgh bridges. This plan is in substantial conformity to that submitted and recommended by a commission of expert engineers, in a report dated October 8, 1901. The scheme proposed was in proper form for the consideration of the Board of Estimate and Apportionment, but persistent objection interposed by the property and lease holders on the line of the proposed extension, supplemented by the divergent opinions among City officials and others, effectually prevented progress. Later it was determined that the Commissioner of Bridges was without authority to construct an elevated railway in Centre street, and that the "McCarren Act" (chapter 712 of the Laws of 1901) permitted only the extension and enlargement of the Manhattan terminal of the Bridge.

Earnest study was devoted toward the improvement of the terminal station; many schemes were considered and elaborate plans proposed, but the problem proved so complex and was restricted by so many conditions beyond the jurisdiction of the Commissioner of Bridges, that effort was finally directed to the possibility of obtaining temporary relief. At a conference held by appointment in the Mayor's office, on September 8, 1902, a committee of the Manufacturers' Association of Brooklyn presented to Mayor Low a plan prepared by Mr. Neils Poulson for rearranging the railway and surface car tracks in the Manhattan terminal. The committee earnestly advocated the adoption of the plan, but, after discussion of the scheme, it was referred to a commission of expert engineers; this commission—appointed by Mayor Low—were Mr. George B. Post, Mr. J. C. Brackenridge and Mr. William Barclay Parsons. In a report submitted September 23, 1903, these engineers disapproved the plan submitted by the Manufacturers' Association, and suggested as an alternative the construction of four additional loop tracks for surface cars. These new loops were built by the railroad companies, they paying about $90,000 and the City $15,000 of the cost of the work. The amount paid by the City was taken from the revenues of the Brooklyn Bridge. The new loops were opened to service on November 15, 1903, and have very materially reduced the crowding in the terminal.

In the spring of 1904 the possibility of permanent relief was again taken up, and plans were prepared for a new station for the Bridge railway, to be built on the block between Centre street and Park row and extending northerly to Worth street. The general scheme was approved by the Board of Estimate and Apportionment, and condemnation proceedings begun toward acquirement of the necessary real estate. Certain of the property-owners questioned the authority of the Commissioner of Bridges to condemn the property for the new station and the powers conferred by chapter 712 of the Laws of 1901, and the subject is still in litigation.

Pending the decision of the courts, effort has been devoted to obtaining a modicum of temporary relief to overcrowded platforms of the Bridge railway, by extending the switching tracks about 150 feet into the City Hall Park and erecting additional platforms, but the necessary authority is still withheld by the Board of Estimate and Apportionment, pending the approval of the Park Department.

The concentration upon the Brooklyn Bridge of most of the passenger travel between the boroughs of Manhattan and Brooklyn has developed abnormal traffic conditions that, in the rush hours tax every means of travel; and whenever the slightest opportunity is afforded or facilities provided the volume of traffic rapidly expands to the limit. When through surface car and elevated railway train service was established upon the Bridge in the year 1898 the daily passenger travel rapidly increased to more than double that of the previous year. The increase was due, to a large extent,, to the stipulation in the leases that the railway companies must include passage over the Bridge as a portion of a continuous route on which a single fare is charged. A count made November 10, 1897, when the Bridge railway (then the only means of transportation upon the Bridge) was operated by the Trustees of the New York and Brooklyn Bridge, showed a total of 144,509 passengers carried in twenty-four hours. A similar count made by the Brooklyn Heights Railroad Company in October 17, 1904, showed a total of 356.976 passengers carried on Bridge railway and in surface cars. This great volume of passenger travel is transported daily with notable regularity, safety and freedom from accident.

The following statement shows the typical passenger travel on the Brooklyn Bridge by years and for a single day in each year

from 1883 to 1904, as determined by actual counts made on the days indicated:

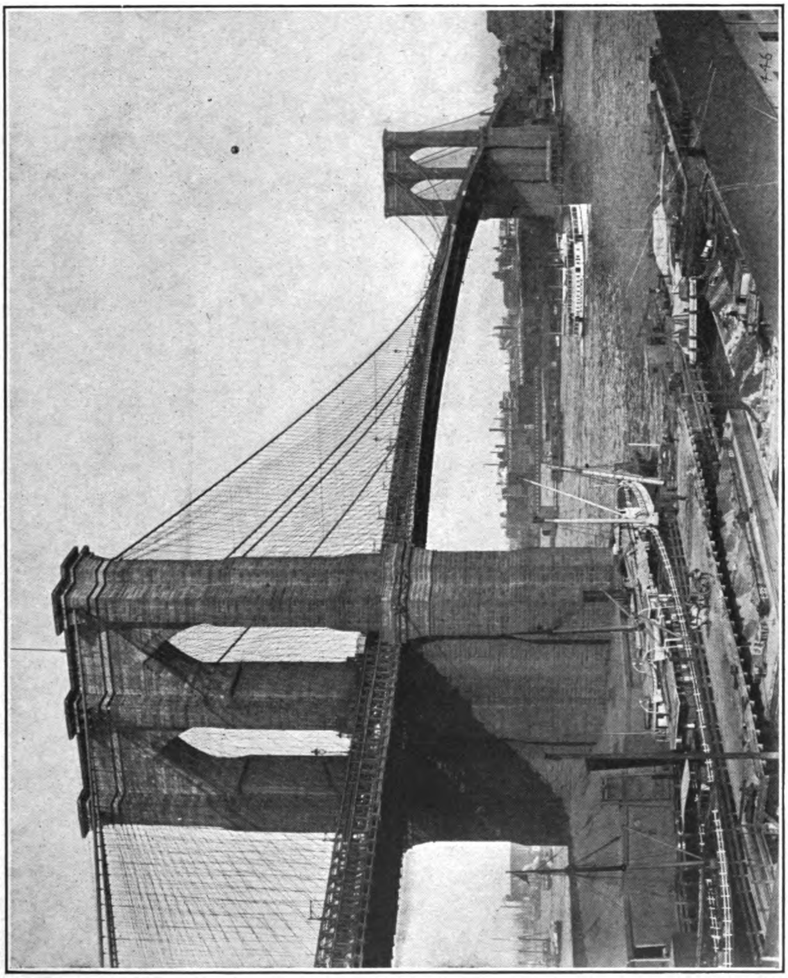
Passenger Traffic on Brooklyn Bridge.

Year.	Railway Passengers. Both Ways for 12 Months Ending November 30.	Typical Day of 24 Hours.	Bridge Railway Passengers. Number by Actual Count for 24 Hours.	Trolley Passengers. Number by Actual Count for 24 Hours.
1883	*1,082,300	† Railway	opened Septem	ber 24, 1883.
1884	8,529,840	May 20	25,300	....
1885	17,177,053	Feb. 24	36,511	....
1886	24,029,267	May 25	70,237	....
1887	27,940,313	Nov. 29	91,130	....
1888	30 331,283	Oct. 31	98,127	....
1889	33,954,773	Oct. 29	110 234	....
1890	37,676,411	Nov. 25	122,298	....
1891	39,766,043	Dec. 2	123 966	....
1892	41,772,898	Dec. 13	129,382	....
1893	42.615,105	Nov. 21	127,237	....
1894	41,704,235	Nov. 27	135,549	....
1895	44,564,329	Oct. 22	133,077	....
1896	43,996,459	Oct. 20	131,281	....
1897	45,542,627	Nov. 10	144,509	....
1898	*19,454,757	....	No record	No record
1899	No record	Nov. 8	149,111	No record
1900	No record	Oct. 31	146,214	129,609
1901	No record	Sept. 4	114,464	168,600
1902	No record	Nov. 10	159,637	147,660
1903	No record	Oct. 26	173,435	147,994
1904	No record	Oct. 17	198,481	158,495

*No annual record kept after June 30, 1898.
The operation of the Bridge Railway was assumed on that date by the Brooklyn Rapid Transit Co.
†Trolley Car Service on the Bridge Roadways began February 16, 1898.
During 1898, no count of Passengers was made.
During 1899, only Bridge Railway Passengers were counted.

When the counts were made by the Brooklyn Heights Railroad Company, in the years 1902, 1903 and 1904, employees of the Department of Bridges also made a record of the people that crossed the Bridge on the promenade and in vehicles. The following statements show the total number of people and direction of travel on the Bridge railway, in surface cars and vehicles and on the promenade on the days indicated:

	To Manhattan.	To Brooklyn.	Total.
Count Made November 10, 1902.			
Passengers in surface cars	74,852	72,808	147,660
Passengers in Bridge cars	65,934	49,169	115,103
Passengers in Elevated Railroad cars	8,716	10,125	18,841
Bridge Local passengers	13,780	11.913	25,693
Totals	163.282	144,015	307,297
Foot passengers on Promenade	6,952	7,496	14,448
People in vehicles (estimated)	4,100	3,800	7,900
Grand totals	174,334	155,311	329,645
Count Made October 26, 1903.			
Passengers in surface cars	73,245	74,749	147,994
Elevated Railway passengers carried in Bridge cars or on through trains	83,333	62,496	145,829
Bridge Local passengers	14,690	12,916	27,608
Totals	171,268	150,161	321,429
Foot passengers on Promenade	4,134	4,911	9,045
People in vehicles	3,050	2,976	6,026
Grand totals	178,452	158,048	336,500
Count Made October 17, 1904.			
Passengers in surface cars	75,974	82,521	158,495
Elevated Railway passengers carried in Bridge cars or on through trains	100,798	71,998	172,796
Local Bridge passengers	13,773	11,912	25,685
Totals	190,545	166,431	356,976
Foot passengers on Promenade	9,207	5,278	14,485
People in vehicles	1,773	1,541	3,314
Grand totals	201,525	173,250	374,775



EAST RIVER BRIDGE NO. I, BROOKLYN BRIDGE.

Bridge Railway.

The train service on the Bridge railway, in the morning from 6 A. M. to 10 A. M., and in the evening from 4 P. M. to 7 P. M. each weekday, consists of four-car Bridge trains, hauled across by cable and switched from the incoming to the outgoing platforms by electric power. At all other hours of the day and night, and on Sundays, the train service consists entirely of through elevated railway trains, operated over the Bridge by electric power, from ten different lines of the Brooklyn Rapid Transit system. Local passengers are carried from Manhattan in the rear car of all trains that load at the westerly platforms.

The majority of the passengers that cross the Bridge each weekday on the Bridge railway are carried in Bridge cars, transferring to or from elevated railway trains at the Brooklyn terminal.

The average weekday passenger travel, determined by several counts made during the months of October, November and December of the year 1904, is about 108,400 passengers carried from Brooklyn to Manhattan; of this number about 78,700, or 72.5 per cent., are carried in Bridge cars; and of about 92,200 passengers carried from Manhattan to Brooklyn, about 67,800, or 73.5 per cent., are carried in the Bridge cars.

In two hours, between 7 A. M. and 9 A. M. of each weekday, 52,000 passengers, or about 48 per cent. of the daily average, are carried from Brooklyn to Manhattan in Bridge cars; and in one and one-half hours, from 5 P. M. to 6.30 P. M., about 48,000 passengers, or about 52 per cent. of the daily average, are carried from Manhattan to Brooklyn.

In the evening rush hours four-car Bridge trains are run at intervals averaging about one minute, or at the rate of 240 cars per hour; during the busiest hours the elevated railway train service on all lines to the Bridge terminal consists of 79 trains, or about 400 cars per hour.

The tables and diagrams which follow show:

The weekday local and through elevated railway train service on the Brooklyn Bridge.

The average number of passengers on weekdays and Sundays on the Bridge railway, as determined by counts made during October, November and December, 1904.

Also tables and diagrams compiled from actual counts made by the Brooklyn Heights Railroad Company on November 10, 1902, October 26, 1903, and October 17, 1904.

These records are typical of the ordinary daily passenger travel on the Brooklyn Bridge.

Weekday Local and Through Elevated Railway Train Service on the Brooklyn Bridge.

LINES.	FIFTH AVE.		FULTON ST.		LEXINGTON AVE.		RIDGEWOOD.		WEST END, BATH BEACH.		CULVER LINE.		BRIGHTON BEACH.		BROOKLYN BRIDGE LOCALS.		Total Number of Trains.	Total Number of Cars.	Interval Between Local Cars from Manhattan.	Power.
Time	Trains.	Cars.	Trains.	Cars.	Trains.	Cars.	Trains.	Cars.	Trains.	Cars.	Trains.	Cars.	Trains.	Cars.	Trains.	Cars.				
A. M. 12.30.....	2	6	2	6	3	9	2	4	2	6	..	..	2	6	..	....	13	37	4 min.	Electric.
1.00.....	2	5	1	3	2	6	1	2	1	3	..	..	..	..	*1	2	8	21	5 "	"
1.30.....	1	2	1	3	1	3	1	2	1	2	..	..	..	..	*1	2	6	14	5 "	"
2.00.....	1	2	1	3	1	3	1	2	1	2	..	..	..	..	*1	2	6	14	5 "	"
2.30.....	1	2	1	3	1	3	1	2	1	2	..	..	..	..	*1	2	6	14	5 "	"
3.00.....	1	2	1	3	1	3	1	2	1	2	..	..	..	..	*1	2	6	14	5 "	"
3.30.....	1	2	1	2	1	2	1	2	1	2	..	..	..	..	*1	2	6	12	5 "	"
4.00.....	1	2	1	2	1	2	1	2	1	2	..	..	..	..	*1	2	6	12	5 "	"
4.30.....	1	2	1	2	1	2	1	2	1	2	..	..	..	..	*1	2	6	12	5 "	"
5.00.....	1	2	1	2	1	2	1	2	1	2	..	..	..	..	*1	2	6	12	5 "	"
5.30.....	1	2	2	5	1	2	1	2	1	2	..	..	..	..	..	..	6	13	5 "	"
6.00.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	24	6	24	5 "	Cable.

6.30.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	12	48	12	48	2.5 min.	"
7.00.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	19	76	19	76	1.5 "	"
7.30.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	24	96	24	96	1.3 "	"
8.00.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	30	120	30	120	1.0 "	"
8.30.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	30	120	30	120	1.0 "	"
9.00.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	30	120	30	120	1.0 "	"
9.30.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	24	96	24	96	1.3 "	"
10.00.....	3	13	3	14	4	16	3	10	1	3	1	4	1	5	5	20	21	85	3 min.	Electric.
10.30.....	3	12	4	17	4	12	3	9	2	6	2	8	2	7	.	..	20	71	3 "	"
11.00.....	3	9	3	11	4	12	3	6	1	3	1	2	2	6	..	..	17	49	3 "	"
11.30.....	3	9	3	9	4	12	3	6	2	6	2	4	1	3	..	..	18	49	3 "	"
12.00 M...	3	9	3	9	4	12	3	6	1	3	1	2	2	6	..	..	17	47	3 "	"
P. M. 12.30.....	3	9	3	9	4	12	3	6	2	6	2	4	1	3	..	..	18	49	3 "	"
1.00.....	3	9	3	9	4	12	3	6	1	3	1	2	2	6	..	..	17	47	3 "	"
1.30.....	3	9	3	9	4	12	3	6	2	6	2	5	1	3	..	..	18	50	3 "	"
2.00.....	3	9	3	9	4	12	3	6	1	3	1	3	2	6	..	..	17	48	3 "	"
2.30.....	3	9	3	9	4	12	3	6	2	6	2	6	1	3	..	..	18	51	3 "	"

Lines.	Fifth Ave.		Fulton St.		Lexington Ave.		Ridgewood.		West End, Bath Beach.		Culver Line.		Brighton Beach.		Brooklyn Bridge Locals.		Total Number of Trains.	Total Number of Cars.	Interval Between Local Cars from Manhattan.	Power.
Time.	Trains.	Cars.	Trains.	Cars.	Trains.	Cars.	Trains.	Cars.	Trains.	Cars.	Trains.	Cars.	Trains.	Cars.	Trains.	Cars.				
P. M. 3.00.....	3	9	3	9	4	12	3	6	1	3	1	3	2	6	.	..	17	48	3 min.	Electric.
3.30.....	3	9	3	9	4	12	3	6	2	6	2	6	1	3	..	..	18	51	3 "	"
4.00.....	3	9	3	9	4	12	3	6	1	3	1	3	2	6	..	..	17	48	3 "	"
4.30.....	..	..	2	8	2	6	1	3	1	3	1	4	1	3	8	32	16	59	3 "	"
5.00.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	19	76	19	76	1.5 min.	Cable.
5.30.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	30	120	30	120	1.0 "	"
6.00.....	..	..	..	..	..	..	..	..	.	..	..	..	..	..	30	120	30	120	1.0 "	"
6.30. ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	28	112	28	112	1.0 "	"
7.00.....	1	5	1	5	1	5	..	..	..	..	..	..	..	..	15	60	18	75	2.0 "	"
7.30.....	3	15	3	15	3	15	3	11	1	3	2	8	2	8	..	..	17	75	3.3 "	Electric.
8.00.....	3	9	3	9	3	9	3	6	2	6	1	4	1	4	..	..	16	47	3.3 "	"
8.30.....	3	9	3	9	3	9	3	6	1	3	2	6	2	6	..	..	17	48	3.3 "	"
9.00....	3	9	3	9	3	9	3	6	2	6	1	2	1	2	..	..	16	43	3.3 "	"
9.30.....	3	9	3	9	3	9	3	6	1	3	2	4	2	4	..	..	17	44	3.3 "	"

10.00.....	3	9	3	9	3	9	3	6	2	6	1	2	1	2	..	..	16	43	3.3	"	"
10.30.....	3	9	3	9	3	9	3	6	1	3	2	4	2	4	..	..	17	44	3.3	"	"
11.00.....	3	9	3	9	3	9	3	6	2	6	1	2	1	2	..	..	16	43	3.3	"	"
11.30.....	3	6	3	9	3	9	3	6	1	3	2	4	2	4	..	..	17	41	3.3	"	"
12.00.....	3	6	3	9	3	9	3	6	2	4	1	2	1	2	..	..	16	38	3.3	"	"
Total Cars.		248		275		304		177		130		94		110		1,258		2,596			

* Elevated Railway trains used as locals.

Average Number of Passengers Carried on Weekday and Sunday on the Brooklyn Bridge Railway, as Determined by Actual Count Made During October, November and December, 1904.

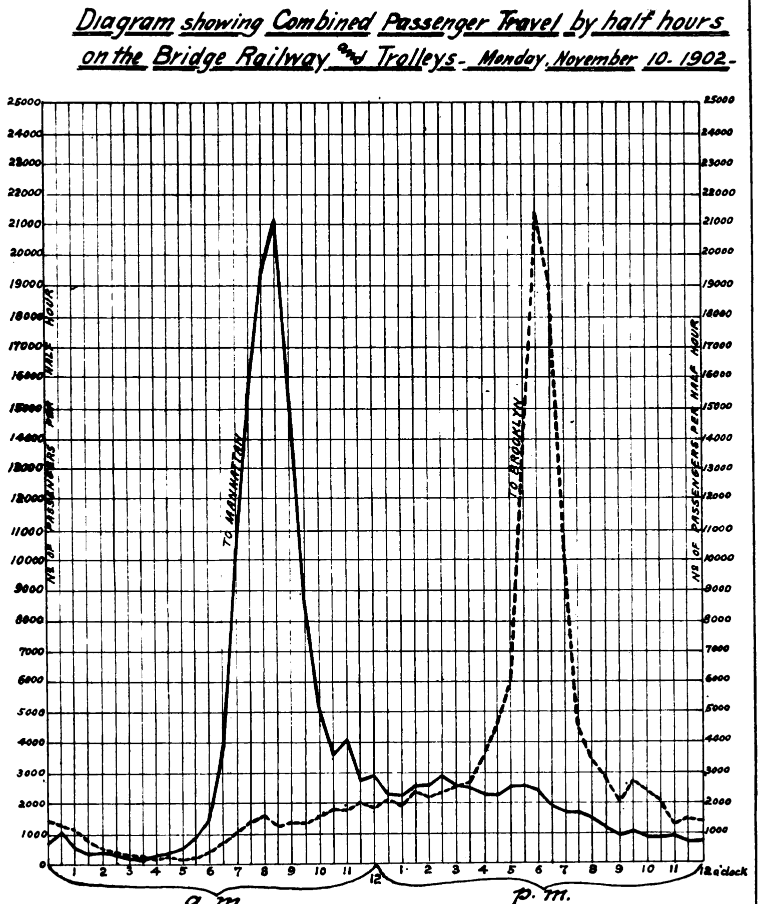
Time.	To Manhattan.			To Brooklyn.		
	Average per day, Monday to Friday.	Saturdays.	Sundays.	Average per day, Monday to Friday.	Saturdays.	Sundays.
A. M.						
12.30	450	305	396	514	472	700
1.00	308	322	314	390	374	666
1.30	244	196	251	288	297	513
2.00	145	123	187	198	221	360
2.30	134	94	182	148	164	279
3.00	90	81	175	128	117	268
3.30	97	87	190	131	108	165
4.00	130	107	84	107	94	155
4.30	151	158	75	89	78	124
5.00	290	296	86	96	60	124
5.30	445	343	80	102	108	150
6.00	888	788	232	231	278	143
6.30	1,645	1,718	460	432	377	160
7.00	3,400	4,068	770	679	607	173
7.30	10,662	9,855	1,745	1,735	1,214	173
8.00	13,652	14,095	1,605	1,202	1,030	220
8.30	13,717	11,705	1,440	706	559	239
9.00	13,661	12,895	1,775	693	602	286
9.30	8,223	6,990	1,845	644	461	306
10.00	3,994	4,080	1,230	552	540	530
10.30	3,017	2,525	1,330	538	677	624
11.00	2,272	2,380	1,390	587	808	815
11.30	1,660	1,970	1,170	613	650	989
12 M.	1,431	1,770	1,200	708	749	1,376

Time.	To Manhattan. Average per day, Monday to Friday.	To Manhattan. Saturdays.	To Manhattan. Sundays.	To Brooklyn. Average per day, Monday to Friday.	To Brooklyn. Saturdays.	To Brooklyn. Sundays.
P. M.						
12.30	1,354	1,655	1,187	673	1,934	1,466
1.00	1,320	1,765	1,040	644	2,223	1,515
1.30	1,399	2,035	1,470	718	2,260	1,620
2.00	1,612	2,305	1,907	769	2,310	1,729
2.30	1,520	1,675	2,315	845	2,266	1,829
3.00	1,422	1,834	2,705	894	2,226	2,132
3.30	1,392	1,405	2,778	1 124	3,667	2,279
4.00	1,198	1,670	2,797	1,483	3,210	1,884
4.30	1,309	1,155	2,060	2,319	4,470	1,664
5.00	1,532	1,854	2,310	4,325	7,550	1,872
5.30	1,939	1,855	2,210	11,198	10,605	2,152
6.00	1,944	1,508	2,374	20,179	10,060	2,214
6.30	1,687	1,380	1,618	17,186	5,715	1,685
7.00	1,366	1,420	2,210	5,986	3,635	1,365
7.30	1,043	1,564	1,479	2,564	2,312	1,110
8.00	1,176	1,706	1,744	1,850	1,915	974
8.30	763	1,249	1,476	1,412	1,206	965
9.00	616	1,131	1,577	1,177	1,020	952
9.30	438	770	1,712	1,176	901	1,064
10.00	560	561	2,083	1,020	837	1,387
10.30	432	926	2,284	962	803	1,357
11.00	530	658	1,800	761	1,161	1,095
11.30	589	477	1,431	746	1,050	1,106
12.00	593	682	1,281	656	967	888
Totals	108,440	110,181	64,060	92,178	84,948	45,832

Combined Passenger Travel on Bridge Railway and Trolleys by Half Hours for Monday, November 10, 1902.

TIME.	BRIDGE RAILWAY PASSENGERS.							TROLLEY CAR PASSENGERS.							Combined Total Both Ways.
	To Manhattan.			To Brooklyn.			Total Both Ways.	To Manhattan.			To Brooklyn.			Total Both Ways.	
	Local.	Elev.	Total.	Local.	Elev.	Total.		B. H. R. R.	C. I. & B. R. R.	Total.	B. H. R. R.	C. I. & B. R. R.	Total.		
A. M.															
12.30	64	479	543	120	496	616	1,159	398	96	494	526	136	662	1,156	2,315
1.00	23	243	266	78	332	410	676	316	71	387	568	150	718	1,105	1,781
1.30	26	79	105	76	192	268	373	172	40	212	412	102	514	726	1,099
2.00	20	132	152	54	137	191	343	129	72	201	224	76	300	501	844
2.30	25	101	126	42	117	159	285	102	56	158	178	72	250	408	693
3.00	11	61	72	28	107	135	207	81	27	108	115	32	147	255	462
3.30	19	70	89	7	109	116	205	61	19	80	109	37	146	226	431
4.00	21	87	108	16	37	53	161	103	20	123	86	16	102	225	386
4.30	19	131	150	19	105	124	274	121	14	135	71	33	104	239	513
5.00	36	213	249	15	55	70	319	128	50	178	76	21	97	275	594
5.50	93	502	595	13	75	88	683	198	83	281	71	24	95	376	1,059
6.00	171	638	809	21	139	160	969	513	126	639	142	52	104	833	1,802
6.30	265	1,922	2,187	46	288	334	2,521	1,353	182	1,535	347	85	432	1,967	4,488
7.00	722	5,605	6,327	179	321	500	6,827	3,386	707	4,093	455	89	544	4,637	11,464
7.30	1,344	7,604	8,948	305	463	768	9,716	5,347	1,107	6,454	559	101	660	7,114	16,830
8.00	1,835	9,919	11,754	339	384	723	12,477	6,174	1,569	7,743	600	277	877	8,620	21,097
8.30	1,265	13,907	15,172	182	360	542	15,714	4,867	1,090	5,957	609	147	756	6,713	22,427
9.00	1,097	8,594	9,691	184	353	537	10,228	4,597	842	5,439	653	158	811	6,250	16,478
9.30	571	4,103	4,674	143	315	458	5,132	3 245	508	3,813	754	125	879	4,692	9,824
10.00	441	1,715	2,156	135	413	548	2,704	2,307	550	2,857	878	192	1,070	3,927	6,631
10.30	247	1,245	1,492	159	426	585	2,077	1,661	513	2,174	992	247	1,239	3,413	5,490
11.00	268	1,411	1,679	140	486	626	2,305	1,910	465	2,375	924	168	1,092	3,467	5,772

11.30	267	876	1,143	144	479	623	1,766	1,304	370	1,674	1,172	205	1,377	3,051	4,817
12.00 M.	199	964	1,163	151	367	518	1,681	1,490	277	1,767	1,117	216	1,333	3,100	4,781
P. M.															
12.30	184	673	857	273	513	786	1,643	1,243	230	1,473	1,187	186	1,373	2,846	4,489
1.00	258	700	958	33	565	598	1,556	984	287	1,271	1,110	228	1,338	2,609	4,165
1.30	270	807	1,077	341	539	880	1,957	1,339	244	1,583	1,261	275	1,536	3,119	5,076
2.00	101	760	861	143	504	647	1,508	1,478	320	1,798	1,342	265	1,607	3,405	4,913
2.30	234	885	1,119	149	651	800	1,919	1,508	317	1,825	1,322	210	1,532	3,357	5,276
3.00	229	714	943	101	780	881	1,824	1,364	330	1,694	1,495	320	1,815	3,509	5,333
3.30	293	591	884	247	767	1,014	1,898	1,397	245	1,642	1,413	293	1,706	3,348	5,246
4.00	166	765	931	257	1,016	1,273	2,204	1,148	228	1,376	2,010	431	2,441	3,817	6,021
4.30	227	579	806	178	1,449	1,627	2,433	1,208	271	1,479	2,400	546	2,946	4,425	6,858
5.00	415	695	1,110	389	1,894	2,283	3,393	1,263	274	1,537	3,037	716	3,753	5,290	8,683
5.30	338	774	1,112	885	7,545	8,430	9,542	1,215	367	1,582	4,836	972	5,808	7,390	16,932
6.00	369	930	1,299	1,659	11,862	13,521	14,820	913	281	1,194	6,508	1,338	7,846	9,040	23,860
6.30	282	716	998	2,005	9,751	11,756	12,754	771	197	968	6,096	1,309	7,405	8,373	21,127
7.00	230	663	893	965	5,309	6,474	7,367	703	167	870	3,426	716	4,142	5,012	12,379
7.30	183	614	797	334	1,918	2,252	3,049	765	179	944	1,870	368	2,238	3,182	6,231
8.00	182	654	836	268	1,352	1,620	2,456	615	108	723	1,609	277	1,886	2,609	5,065
8.30	103	439	542	212	1,086	1,298	1,840	495	134	629	1,367	246	1,613	2,242	4,082
9.00	172	270	442	83	527	610	1,052	460	84	544	1,154	268	1,422	1,966	3,018
9.30	105	394	499	231	1,176	1,407	1,906	416	90	506	1,055	295	1,350	1,856	3,762
10.00	92	279	371	135	1,056	1,191	1,562	398	126	524	991	207	1,198	1,722	3,284
10.30	66	264	330	122	838	960	1,290	448	77	525	899	226	1,125	1,650	2,940
11.00	72	356	428	120	422	542	970	395	83	478	571	161	732	1,210	2,180
11.30	96	255	351	124	528	652	1,003	319	76	395	641	151	792	1,187	2,190
12.00	64	272	336	66	487	553	889	316	99	415	648	157	805	1,220	2,109
Totals	13,780	74,650	88,430	11,913	59,294	71,207	159,637	61,124	13,728	74,852	59,886	12,922	72,808	147,660	307,297



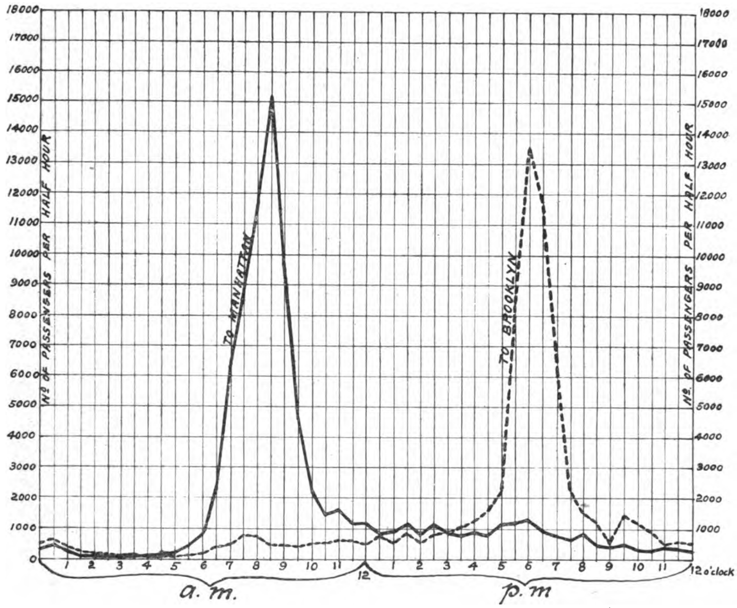
To Manhattan 163282
To Brooklyn 144015
Total both ways 307297

Maximum per half hour
To Manhattan. 21129
To Brooklyn 21367

Brooklyn Bridge

Tables and Diagrams of Passenger and Car Traffic for Monday, November 10 - 1902.

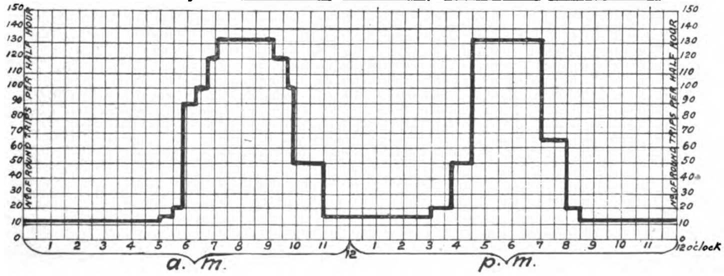
Diagram showing Passenger Travel by half hours on the Bridge Railway - Monday, November 10. 1902 -



To Manhattan 88430
To Brooklyn 71207
Total both ways 159637

Maximum per half hour
To Manhattan 15172
To Brooklyn 13521

Diagram showing Bridge Railway Car Service Round Trips by half hours - Monday, November 10. 1902.



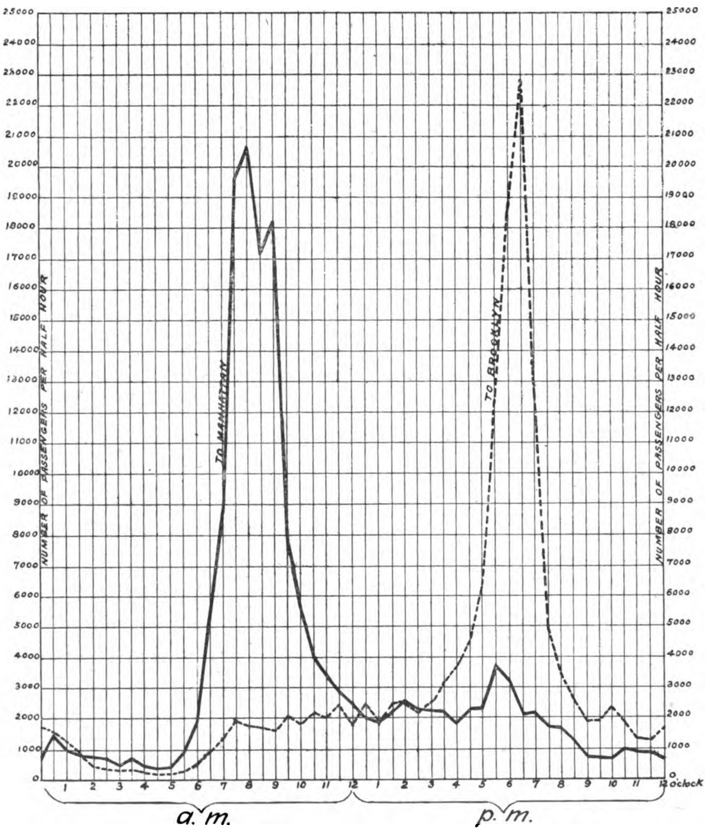
Highest number of Cars per half hour 132
Lowest " " " " " 12

Combined Passenger Travel on Bridge Railway and Trolleys by Half Hours for Monday, October 26, 1903.

TIME.	BRIDGE RAILWAY PASSENGERS.							TROLLEY CAR PASSENGERS.							Combined Total Both Ways.
	To Manhattan.			To Brooklyn.			Total Both Ways.	To Manhattan.			To Brooklyn.			Total Both Ways.	
	Local.	Elev.	Total.	Local.	Elev.	Total.		B. H. R. R.	C. I. & B. R. R.	Total.	B. H. R. R.	C. I. & B. R. R.	Total		
A. M.															
12.30	45	1,092	1,137	147	503	650	1,787	376	94	470	732	229	961	1,431	3,218
1.00	40	665	705	98	220	318	1,023	249	78	327	790	126	916	1,243	2,266
1.30	28	510	538	106	211	317	855	240	53	293	460	108	568	861	1,716
2.00	8	636	644	36	128	164	808	121	40	161	262	57	319	480	1,288
2.30	17	557	574	32	103	135	709	128	58	186	191	39	230	416	1,125
3.00	10	353	363	27	112	139	502	128	12	140	158	44	202	342	844
3.30	8	549	557	23	129	152	709	127	23	150	119	35	154	304	1,013
4.00	17	329	346	18	86	104	450	74	19	93	107	27	134	227	677
4.30	15	201	216	15	54	69	285	112	16	128	121	11	132	260	545
5.00	42	187	229	19	60	79	308	178	41	219	100	12	112	331	639
5.30	112	480	592	25	92	117	709	241	78	319	82	61	143	462	1,171
6.00	215	1,000	1,215	39	173	212	1,427	604	139	743	180	60	240	983	2,410
6.30	347	3,497	3,844	53	291	344	4,188	1,376	254	1,630	554	92	646	2,276	6,464
7.00	629	3,938	4,567	168	396	564	5,131	3,558	831	4,389	633	114	747	5,136	10,267
7.30	1,435	11,543	12,978	467	432	899	13,877	5,623	1,070	6,693	878	155	1,033	7,726	21,603
8.00	2,146	10,834	12,980	392	528	920	13,900	6,405	1,161	7,566	686	144	830	8,396	22,296
8.30	1,638	10,698	12,336	228	585	813	13,149	4,118	662	4,780	707	177	884	5,664	18,813
9.00	1,167	11,220	12,387	245	466	711	13,098	4,708	1,096	5,804	816	101	917	6,721	19,819
9.30	487	3,872	4,359	249	496	745	5,104	3,018	691	3,709	1,082	206	1,288	4,997	10,101
10.00	313	2,932	3,245	241	401	642	3,887	2,041	557	2,598	1,000	193	1,193	3,791	7,678
10.30	328	1,918	2,244	176	610	786	3,030	1,499	277	1,776	1,128	160	1,288	3,064	6,094
11.00	242	1,275	1,517	168	578	746	2,263	1,816	342	2,158	1,027	238	1,265	3,423	5,686

11.30	212	1,054	1,276	185	561	746	2,022	1,289	428	1,717	1,446	215	1,661	3,378	5,400
12 M.	201	772	973	145	628	773	1,746	1,261	304	1,565	875	138	1,013	2,578	4,324
P. M.															
12.30	197	454	651	222	717	939	1,590	1,158	215	1,373	1,245	274	1,519	2,892	4,482
1.00	153	426	579	79	531	610	1,189	1,132	325	1,367	1,067	159	1,226	2,593	3,782
1.30	235	489	724	263	774	1,037	1,761	1,303	216	1,519	1,320	214	1,534	3,053	4,814
2.00	252	596	848	190	674	864	1,712	1,408	331	1,739	1,508	208	1,716	3,455	5,167
2.30	235	420	655	150	656	806	1,461	1,321	317	1,638	1,139	268	1,407	3,045	4,506
3.00	238	395	633	180	660	840	1,473	1,363	266	1,629	1,446	247	1,693	3,322	4,795
3.30	226	473	699	250	1,012	1,262	1,961	1,256	237	1,493	1,419	414	1,833	3,326	5,287
4.00	193	314	507	175	1,158	1,233	1,740	1,126	211	1,337	2,170	281	2,451	3,788	5,528
4.30	253	657	910	359	1,050	1,409	2,319	1,155	220	1,375	2,605	487	3,092	4,467	6,786
5.00	261	656	917	379	2,686	3,065	3,982	1,159	146	1,305	2,602	509	3,111	4,416	8,398
5.30	706	1,192	1,898	946	5,184	6,130	8,028	1,647	172	1,819	5,034	1,195	6,229	8,048	16,076
6.00	453	1,151	1,604	2,049	8,597	10,646	12,250	1,465	217	1,682	6,770	1,274	8,044	9,726	21,976
6.30	271	896	1,167	1,916	13,763	15,679	16,846	784	139	923	6,091	1,131	7,222	8,145	24,991
7.00	214	957	1,171	779	8,186	8,965	10,136	774	169	943	3,183	721	3,904	4,847	14,983
7.30	205	679	884	446	2,395	2,841	3,725	723	168	891	1,783	413	2,196	3,087	6,812
8.00	203	543	796	256	1,278	1,534	2,330	749	160	909	1,635	345	1,980	2,889	5,219
8.30	124	586	710	191	897	1,088	1,798	515	61	576	1,282	277	1,559	2,135	3,933
9.00	98	224	342	137	712	849	1,191	357	81	438	929	127	1,056	1,494	2,685
9.30	78	242	320	147	654	801	1,121	334	105	439	881	234	1,115	1,554	2,675
10.00	55	240	295	152	968	1,120	1,415	333	108	441	934	240	1,174	1,615	3,030
10.30	80	523	603	130	760	890	1,493	331	69	400	838	193	1,031	1,431	2,924
11.00	121	455	576	133	462	595	1,171	295	87	382	663	125	788	1,170	2,341
11.30	70	414	484	106	471	577	1,061	380	96	476	557	150	707	1,183	2,244
12.00	67	616	228	79	408	487	715	422	115	537	1,121	165	1,286	1,823	2,538
Totals	14,690	83,333	98,023	12,916	62,496	75,412	173,435	60,780	12,465	73,245	62,356	12,393	74,749	147,994	321 429

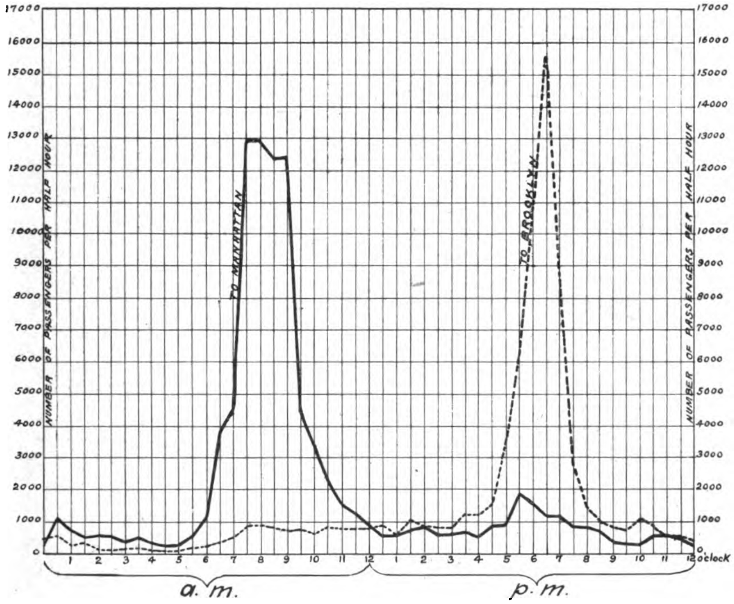
Diagram showing Combined Passenger Travel by half hours on the Bridge Railway and Trolleys for Monday Oct. 26. 1903.



To Manhattan 171268
To Brooklyn 150161
Total both ways. 321429

Maximum per half hour
To Manhattan 20546
To Brooklyn 22901

Diagram showing Passenger Travel by half hours on the Bridge Railway for Monday Oct. 26 - 1903.

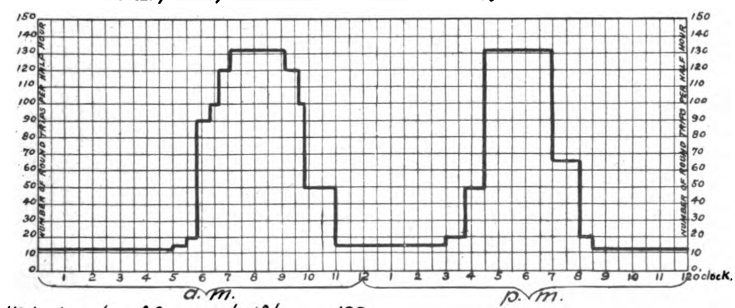


To Manhattan	98023
To Brooklyn	75412
Total both ways	173435

Maximum per half hour

To Manhattan	12980
To Brooklyn	15679

Diagram showing Bridge Railway Car Service Round Trips by half hours for Monday Oct. 26 - 1903.



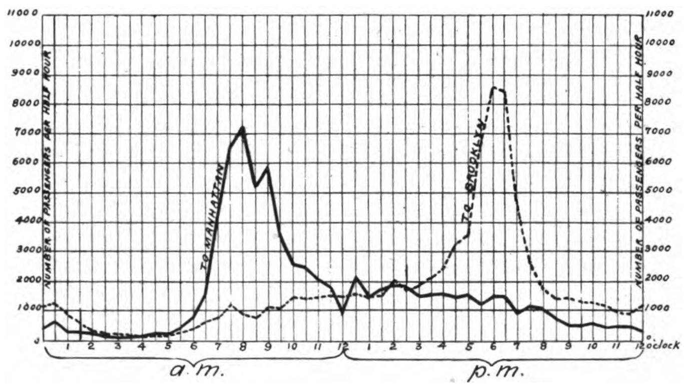
Highest number of Cars per half hour 132
Lowest " " " " " " 12

Combined Passenger Travel on Bridge Railway and Trolleys by Half Hours for Monday, October 17, 1904.

TIME.	BRIDGE RAILWAY PASSENGERS.							TROLLEY CAR PASSENGERS.							Combined Total Both Ways.
	To Manhattan.			To Brooklyn.			Total Both Ways.	To Manhattan.			To Brooklyn.			Total Both Ways.	
	Local.	Elev.	Total.	Local.	Elev.	Total.		B. H. R. R.	C. I. & B. R. R.	Total.	B. H. R. R.	C. I. & B. R. R.	Total.		
A. M.															
12.30	66	977	1,043	130	506	636	1,679	478	132	610	1,026	228	1,254	1,864	3,543
1.00	42	477	519	93	517	610	1,129	248	38	286	676	170	846	1,132	2,261
1.30	17	233	250	83	334	417	667	206	75	281	550	137	687	968	1,635
2.00	13	213	226	53	202	255	481	193	78	271	275	77	352	623	1,104
2.30	7	162	169	50	148	198	367	118	54	172	222	44	266	438	805
3.00	12	100	112	15	227	242	354	84	19	103	187	52	239	342	696
3.30	7	91	98	31	120	151	249	72	19	91	124	48	172	263	512
4.00	11	111	122	9	101	110	232	86	13	99	111	34	145	244	476
4.30	22	164	186	18	98	116	302	127	46	173	128	19	147	320	622
5.00	45	263	308	14	63	77	385	106	36	142	89	33	122	264	649
5.30	77	483	560	13	91	104	664	250	64	314	186	57	243	557	1,221
6.00	200	1,206	1,406	21	125	146	1,552	591	160	751	236	140	376	1,127	2,679
6.30	325	2,036	2,361	67	483	550	2,911	1,452	174	1,626	513	117	630	2,256	5,167
7.00	604	5,294	5,898	177	527	704	6,602	3,499	702	4,201	600	133	733	4,934	11,536
7.30	1,512	10,716	12,228	475	818	1,293	13,521	5,253	1,314	6,567	1,007	139	1,146	7,713	21,234
8.00	2,011	17,878	19,889	517	521	1,038	20,927	6,077	1,025	7,102	796	162	958	8,060	28,987
8.30	1,198	13,529	14,727	215	494	709	15,436	4,221	908	5,129	660	141	801	5,930	21,366
9.00	1,095	8,588	9,683	250	545	795	10,478	4,916	1,020	5,936	928	178	1,106	7,042	17,520
9.30	446	5,463	5,909	233	692	925	6,834	2,918	587	3,505	914	196	1,110	4,615	11,449
10.00	299	3,696	3,995	159	566	725	4,720	2,081	568	2,649	1,088	322	1,410	4,059	8,779
10.30	305	2,215	2,520	128	517	645	3,165	2,068	437	2,505	1,131	187	1,318	3,823	6,988
11.00	239	1,605	1,844	180	724	904	2,748	1,651	416	2,067	1,290	229	1,519	3,586	6,334

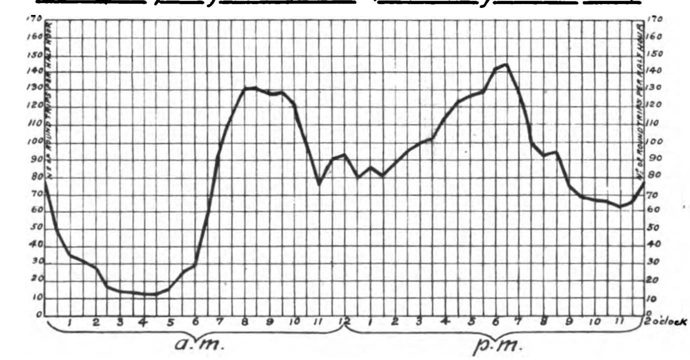
11.30	305	1,199	1,504	139	622	761	2,265	1,343	504	1,847	1,280	290	1,570	3,417	5,682
12.00 M.	52	1,592	1,644	93	883	976	2,620	738	199	937	1,107	302	1,409	2,346	4,966
P. M.															
12.30	205	540	745	171	883	1,054	1,799	1,683	446	2,129	1,291	361	1,652	3,781	5,580
1.00	213	907	1,120	186	973	1,159	2,279	1,056	339	1,395	1,293	282	1,575	2,970	5,249
1.30	92	1,058	1,150	167	831	998	2,148	1,404	329	1,733	1,155	291	1,446	3,179	5,327
2.00	331	1,056	1,387	181	547	728	2,115	1,507	439	1,946	1,667	341	2,008	3,954	6,069
2.30	230	1,245	1,475	144	1,194	1,338	2,813	1,448	469	1,917	1,396	336	1,732	3,649	6,462
3.00	195	954	1,149	117	997	1,114	2,263	1,250	297	1,547	1,580	372	1,952	3,499	5,762
3.30	185	1,007	1,192	177	1,191	1,368	2,560	1,202	372	1,574	1,720	363	2,083	3,657	6,217
4.00	213	1,099	1,312	135	1,554	1,689	3,001	1,312	320	1,632	1,910	512	2,422	4,054	7,055
4.30	221	753	974	278	1,115	1,393	2,367	1,166	233	1,399	2,577	627	3,204	4,603	6,970
5.00	293	941	1,234	334	2,831	3,165	4,399	1,103	391	1,494	2,784	747	3,531	5,025	9,424
5.30	685	1,300	1,985	709	7,563	8,272	10,257	1,565	262	1,827	5,421	1,265	6,686	8,513	18,770
6.00	409	2,077	2,485	1,652	15,114	16,766	19,252	1,288	308	1,596	7,138	1,452	8,590	10,186	29,438
6.30	284	1,359	1,643	1,792	11,276	13,068	14,711	1,070	392	1,462	7,014	1,356	8,370	9,832	24,543
7.00	179	773	952	915	4,039	4,954	5,906	752	140	892	4,050	759	3,809	5,701	11,607
7.30	190	1,333	1,523	437	3,752	4,189	5,712	816	226	1,042	2,177	516	2,693	3,735	9,447
8.00	210	1,340	1,550	286	1,657	1,943	3,493	832	180	1,012	1,500	309	1,809	2,881	6,314
8.30	154	593	747	149	984	1,133	1,880	588	127	715	1,141	255	1,396	2,111	3,991
9.00	103	1,577	1,680	156	1,070	1,226	2,906	456	81	537	1,159	252	1,411	1,948	4,854
9.30	84	372	456	135	1,249	1,384	1,840	380	94	474	973	279	1,252	1,726	3,566
10.00	76	655	731	139	750	889	1,620	428	119	547	1,022	195	1,217	1,764	3,384
10.30	59	464	523	157	754	911	1,434	366	77	443	885	215	1,100	1,543	2,977
11.00	81	394	475	137	655	792	1,267	380	110	490	780	207	987	1,477	2,744
11.30	105	339	444	110	615	725	1,169	365	111	476	759	201	960	1,436	2,605
12.00	66	371	437	85	480	565	1,002	248	83	331	848	229	1,077	1,408	2,410
Totals	13,773	100,798	114,571	11,912	71,998	83,910	198,481	61,441	14,533	75,974	67,364	15,157	82,521	158,495	356,976

Diagram showing Passenger Travel by half hours in Trolley Cars for Monday October 17. 1904.



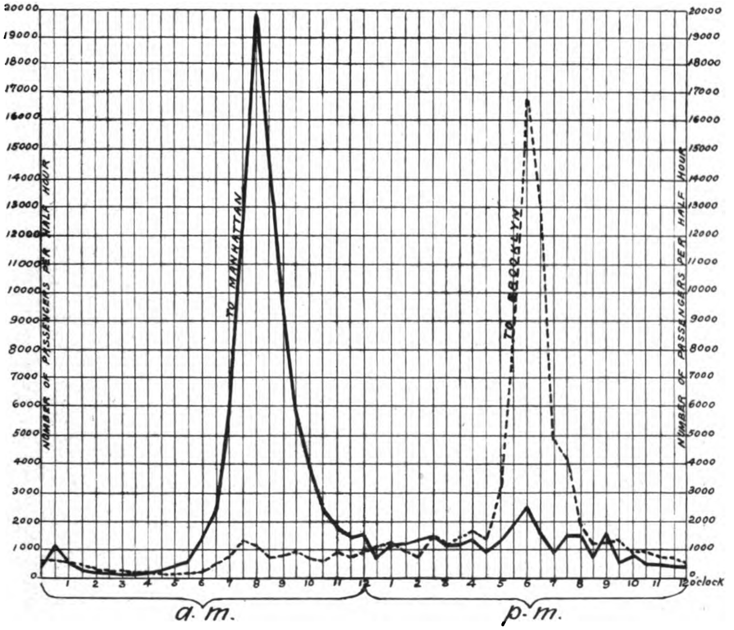
To Manhattan	75974	Maximum per half hour	
To Brooklyn	82521	To Manhattan	7102
Total both ways	158495	To Brooklyn	8590

Diagram showing Trolley Car Service Round Trips by half hours - for Monday Oct. 17. 1904.



Highest number of cars per half hour 145
Lowest " " " " " " 13
Total number of round trips for 24 hours. 3840

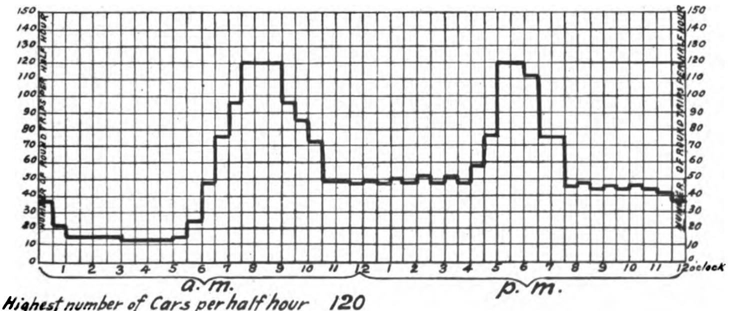
Diagram showing Passenger Travel by half hours on the Bridge Railway for Monday Oct. 17. 1904.



To Manhattan 114571
To Brooklyn 83910
Total both ways 198481

Maximum per half hour
To Manhattan 19889
To Brooklyn 16766

Diagram showing Bridge Railway Car Service Round Trips by half hours for Monday Oct. 17. 1904.



Highest number of Cars per half hour 120
Lowest " " " " " " 12

SURFACE CARS.

The total number of surface car round trips on the Bridge each year, from 1898 to 1904, inclusive, is shown in the following statement:

	Brooklyn Rapid Transit System.	Coney Island and Brooklyn Railroad Company.	Total.
1898	959,645	159.703	1,119,348
1899	1,168,592	211,223	1,379,815
1900	1,126,338	222,526	1,348,864
1901	1,172,935	225,136	1,398,071
1902	1,046,201	229,321	1,275,522
1903	1,072,491	226,617	1,299,108
1904	1,c92,907	234,460	1,327,367

The tables and diagrams which follow show the number by half hours of passengers in surface cars, according to actual counts taken by the Brooklyn Heights Railroad Company on November 10, 1902, October 26, 1903, and October 17, 1904. Also the average number of surface car round trips per Sunday and per weekday in each month, and the total number in each month, during the years 1902, 1903 and 1904:

BROOKLYN BRIDGE.

Passenger Travel by Half Hours in Trolley Cars to Brooklyn, November 10, 1902.

TIME.	Name of Car Line.																			Grand Total.
	Fulton Street.	Putnam Avenue.	Gates Avenue.	Myrtle Avenue.	Ralph Avenue.	Flatbush Avenue.	Third Avenue.	Court Street.	Graham Avenue.	Flushing Avenue.	Seventh Avenue.	Park Avenue.	Bergen Street.	Vanderbilt Avenue.	Douglass Street.	Total Brooklyn Heights.	DeKalb Avenue.	Smith Street.	Total C. I. & Br.	
A. M. 12.30......	43	41	35	47	13	22	27	19	65	55	59	38	15	16	31	526	53	83	136	662
1.00......	28	58	24	85	21	28	42	23	106	42	28	21	18	28	16	568	45	105	150	718
1.30......	27	39	68	27	51	28	13	..	25	18	29	18	34	9	26	412	46	56	102	514
2.00......	10	31	38	21	15	19	15	..	25	24	7	..	9	10	..	224	31	45	76	300
2.30......	24	9	40	21	....	14	6	..	24	15	15	..	6	4	..	178	21	51	72	250
3.00......	18	20	9	14	....	5	13	..	12	9	15	..	..	..	..	115	22	10	32	147
3.30......	14	19	21	23	....	5	6	..	8	..	9	..	4	..	..	109	7	30	37	146
4.00......	18	15	4	13	....	5	1	..	13	6	11	..	..	..	..	86	7	9	16	102
4.30......	14	8	....	5	....	4	6	..	29	..	5	..	..	..	..	71	7	26	33	104
5.00......	9	10	4	16	....	6	4	..	10	6	11	..	..	..	..	76	....	21	21	97
5.30......	10	2	18	6	....	10	3	..	22	..	..	..	..	..	..	71	2	22	24	95
6.00......	4	7	3	4	1	18	17	..	42	22	14	2	6	2	..	142	7	45	52	194
6.30......	33	9	4	15	11	2	56	8	68	41	11	32	32	25	..	347	14	71	85	432
7.00......	24	12	19	27	15	29	49	10	122	47	28	27	24	22	..	455	24	65	89	544

TIME.	Name of Car Line.																		Grand Total.
	Fulton Street.	Putnam Avenue.	Gates Avenue.	Myrtle Avenue.	Ralph Avenue.	Flatbush Avenue.	Third Avenue.	Court Street.	Graham Avenue.	Flushing Avenue.	Seventh Avenue.	Park Avenue.	Bergen Street.	Vanderbilt Avenue.	Douglass Street.	Total Brooklyn Heights.	DeKalb Avenue.	Smith Street.	Total C.I. & Br.	
A. M. 7.30......	81	12	26	25	10	56	42	11	154	41	23	9	42	27	..	559	55	46	101	660
8.00......	63	21	21	29	8	50	74	30	152	48	32	19	39	14	..	600	181	96	277	877
8.30......	133	13	28	28	9	84	50	19	83	32	42	28	40	20	..	609	89	58	147	756
9.00......	133	13	24	35	13	42	48	56	115	64	52	21	13	24	..	653	103	55	158	811
9.30......	169	16	66	31	17	61	61	48	84	52	57	32	38	22	..	754	62	63	125	879
10.00.....	157	91	67	44	4	81	81	58	107	59	40	32	40	17	..	878	117	75	192	1,070
10.30.....	85	64	124	27	49	76	73	65	138	48	83	61	52	47	..	992	134	113	247	1,239
11.00.....	119	68	98	56	15	95	86	33	138	38	50	48	44	36	..	924	94	74	168	1,092
11.30.....	176	60	117	41	27	104	89	90	169	53	75	36	80	55	..	1,172	113	92	205	1,377
12 M......	83	110	106	76	28	123	103	78	117	38	65	50	72	68	..	1,117	133	83	216	1,333
P. M. 12.30.....	119	97	137	64	33	119	69	77	185	65	58	26	76	62	..	1,187	88	98	186	1,373
1.00......	170	53	84	44	34	136	93	59	157	33	74	60	54	59	..	1,110	153	75	228	1,338
1.30	151	116	115	64	47	124	112	71	208	31	65	34	77	46	..	1,261	161	114	275	1,536
2.00......	167	107	117	91	19	97	94	98	159	41	135	55	109	53	..	1,342	164	101	265	1,607
2.30	246	98	116	89	31	85	86	73	177	65	84	53	64	55	..	1,322	113	97	210	1,532
3.00......	142	137	147	81	42	142	86	103	150	108	110	86	69	92	..	1,495	190	130	320	1,815
3.30......	142	107	129	58	73	125	108	100	167	99	82	63	89	71	..	1,413	171	122	293	1,706

4.00......	297	199	163	95	65	257	148	118	135	62	156	89	120	106	..	2,010	266	165	431	2,441
4.30......	273	177	198	102	64	220	168	146	240	123	170	169	180	170	..	2,400	335	211	546	2,946
5.00......	256	242	222	165	130	260	149	193	326	197	304	210	203	180	..	3,037	422	294	716	3,753
5.30......	592	366	279	211	180	264	212	235	601	369	308	353	386	480	..	4,836	539	433	972	5,808
6.00......	498	297	405	464	280	368	289	357	918	534	367	546	623	562	..	6,508	793	545	1,338	7,846
6.30......	577	396	277	511	180	129	148	415	1,423	438	585	281	391	405	..	6,096	819	490	1,309	7,405
7.00......	182	273	197	255	123	372	210	132	420	180	226	328	205	323	..	3,426	398	318	716	4,142
7.30......	193	127	189	121	50	128	78	101	277	83	138	156	135	94	..	1,870	188	180	368	2,238
8.00......	136	88	154	91	74	93	75	75	196	103	134	136	171	83	..	1,609	181	96	277	1,886
8.30......	196	72	108	87	44	78	78	62	174	106	83	123	101	55	..	1,367	147	99	246	1,613
9.00......	152	78	112	80	56	64	73	34	139	66	48	86	96	70	..	1,154	123	145	268	1,422
9.30......	118	66	107	64	67	84	58	45	140	75	64	75	66	26	..	1,055	147	148	295	1,350
10.00.....	109	54	126	42	47	71	55	36	125	100	70	58	33	65	..	991	109	98	207	1,198
10.30.....	68	90	100	63	25	36	39	64	129	48	66	45	89	37	..	899	113	113	226	1 125
11.00.....	57	51	58	38	31	53	25	16	72	26	58	28	29	29	..	571	67	94	161	732
11.30.....	61	82	91	21	27	44	35	44	71	15	31	15	60	44	..	641	59	92	151	792
12.00.....	70	66	65	51	41	46	27	27	70	32	52	29	31	41	..	648	82	75	157	805
Totals..	6,447	4,187	4,660	3,668	2,070	4,362	3,480	3,229	8,487	3,757	4,229	3,518	4.065	3,654	73	59,886	7,195	5,727	12,922	72,808

BROOKLYN BRIDGE.

Passenger Travel by Half Hours in Trolley Cars to Manhattan, November 10, 1902.

TIME.	Name of Car Line.																			Grand Total.
	Fulton St.	Putnam Ave.	Gates Ave.	Myrtle Ave.	Ralph Ave.	Flatbush Ave.	Third Ave.	Court St.	Graham Ave.	Flushing Ave.	Seventh Ave.	Park Ave.	Bergen St.	Vanderbilt Ave.	Douglass St.	Total Br. Heights.	DeKalb Ave.	Smith St.	Total C. I. & Br.	
A. M. 12.30	39	43	15	16	9	29	11	14	60	34	32	14	14	8	60	398	43	53	96	494
1.00	22	27	33	21	19	15	16	9	41	22	17	11	38	15	10	316	27	44	71	387
1.30	9	10	20	13	15	16	10	....	25	19	9	....	10	2	14	172	7	33	40	212
2.00	8	11	16	12	6	9	3	....	30	20	....	....	12	2	....	129	14	58	72	201
2.30	11	12	4	24	....	3	6	....	5	12	8	....	17	....	....	102	12	44	56	158
3.00	28	9	17	4	....	2	8	....	....	11	2	....	....	....	....	81	5	22	27	108
3.30	5	4	3	7	....	2	2	....	29	...	7	....	2	....	....	61	11	8	19	80
4.00	6	12	6	27	....	3	5	....	33	5	6	....	....	....	....	103	14	6	20	123
4.30	14	5	12	17	....	7	4	....	39	....	23	....	....	....	....	121	....	14	14	135
5.00	9	19	24	17	....	....	7	....	19	25	8	....	....	....	....	128	28	22	50	178
5.30	19	19	12	17	....	16	14	....	101	....	....	....	....	....	....	198	32	51	83	281
6.00	23	17	27	34	16	9	30	....	142	67	46	53	34	15	....	513	40	86	126	639
6.30	49	54	86	93	44	51	99	37	380	150	70	166	45	29	....	1,353	57	125	182	1,535
7.00	77	167	177	240	115	87	190	75	855	331	165	439	175	293	....	3,386	316	391	707	4,093
7.30	269	283	256	367	111	306	256	225	1,278	578	365	404	346	303	....	5,347	621	486	1,107	6,454

8.00.....	365	328	351	252	166	459	265	382	1,044	524	439	575	535	489	....	6,174	932	637	1,569	7,743
8.30.....	417	359	276	157	118	334	366	252	739	389	326	376	370	388	....	4,867	668	422	1,090	5,957
9.00.....	425	344	226	193	89	321	265	184	724	291	516	230	319	470	....	4,597	621	221	842	5,439
9.30....	364	246	187	102	111	334	311	130	351	169	333	180	276	151	....	3,245	443	125	568	3,813
10.00.....	124	200	191	91	66	273	184	128	256	165	228	98	177	126	....	2,307	283	267	550	2,857
10.30.....	110	168	165	52	87	178	142	84	181	89	76	111	108	110	....	1,661	375	138	513	2,174
11.00.....	241	106	147	108	49	279	216	155	160	64	59	92	150	84	....	1,910	305	160	465	2,375
11.30.....	79	101	107	50	60	93	130	87	247	37	75	49	99	90	....	1,304	247	123	370	1,674
12.00 M...	138	161	113	64	47	189	184	51	182	74	98	76	47	66	....	1,490	177	100	277	1,767
P. M. 12.30.....	173	115	70	46	43	161	86	87	178	46	72	29	66	71	....	1,243	152	78	230	1,473
1.00.....	78	54	144	47	37	112	92	84	121	19	37	51	59	49	....	984	151	136	287	1,271
1.30.....	127	145	87	49	79	152	114	74	214	37	37	28	124	72	....	1,339	146	98	244	1,583
2.00.....	165	61	146	76	46	95	105	85	353	55	117	58	70	46	....	1,478	214	106	320	1,798
2.30.....	161	134	130	87	49	186	121	71	140	111	88	51	97	82	....	1,508	206	111	317	1,825
3.00.....	127	109	130	75	29	136	149	90	125	72	83	65	90	84	....	1,364	229	101	330	1,694
3.30.....	85	78	102	38	78	133	127	113	182	142	72	72	103	72	....	1,397	140	105	245	1,642
4.00.....	93	75	68	26	56	115	129	58	187	68	61	68	69	75	....	1,148	164	64	228	1,376
4.30.....	104	108	93	65	30	82	134	63	149	110	72	70	68	60	....	1,208	207	64	271	1,479
5.00.....	90	47	66	49	67	135	138	67	235	120	52	76	88	33	....	1,263	154	120	274	1,537
5.30.....	189	46	44	22	33	101	99	78	259	89	50	73	72	60	....	1,215	178	189	367	1,582
6.00.....	111	8	16	59	38	61	68	63	172	41	36	49	121	70	....	913	111	170	281	1,194
6.30.....	102	20	18	46	24	46	73	34	134	82	36	39	78	39	....	771	75	122	197	968
7.00.....	48	31	63	55	11	56	68	42	123	27	40	47	28	64	....	703	93	74	167	870

TIME.	Name of Car Line.																			Grand Total.
	Fulton St.	Putnam Ave.	Gates Ave.	Myrtle Ave.	Ralph Ave.	Flatbush Ave.	Third Ave.	Court St.	Graham Ave.	Flushing Ave.	Seventh Ave.	Park Ave.	Bergen St.	Vanderbilt Ave.	Douglass St.	Total Br. Heights.	DeKalb Ave.	Smith St.	Total C. I. & Br.	
P.M. 7.30.....	55	59	79	26	22	79	34	43	130	48	37	40	67	46	....	765	93	86	179	944
8.00.....	81	19	41	22	30	46	53	29	64	39	32	88	48	23	....	615	45	63	108	723
8.30.....	85	40	21	23	18	32	59	34	77	10	8	17	34	37	....	495	40	94	134	629
9.00.....	86	17	49	30	14	28	33	25	23	33	16	50	22	34	....	460	42	42	84	544
9.30.....	41	36	35	16	17	33	37	24	50	42	39	24	15	7	....	416	39	51	90	506
10 00.....	32	28	59	20	40	29	34	13	64	21	11	12	22	13	....	398	82	44	126	524
10.30.....	39	26	45	27	16	39	42	20	35	16	36	34	33	40	....	448	42	35	77	525
11.00.....	36	59	38	18	21	33	18	17	47	23	19	8	34	24	....	395	30	53	83	478
11.30.....	33	32	38	10	19	55	12	17	35	9	18	12	19	10	....	319	53	23	76	395
12.00.....	29	34	39	16	13	28	37	15	37	7	14	9	13	25	....	316	67	32	99	415
Totals ..	5,021	4,086	4,092	2,926	1,958	4,988	4,586	3,059	10,055	4,343	3,991	3,944	4,214	3,777	84	61,124	8,031	5,697	13,728	74,852

Brooklyn Bridge—Trolley Car Passengers to Brooklyn.

Count of Passengers by Half Hours for Monday, October 26, 1903.

TIME.	Fulton Avenue.	Putnam Avenue.	Gates Avenue.	Myrtle Avenue.	Ralph Avenue.	Flatbush Avenue.	Third Avenue.	Court Street.	Graham Avenue.	Flushing Avenue.	Seventh Avenue.	Park Avenue.	Bergen Street.	Vanderbilt Avenue.	Flushing-Knick.	Douglass Street.	Total B. H. R. R. Lines.	DeKalb Avenue.	Smith Street.	Total C.I.& B.R. Lines.	Grand Total Surface Lines.
	Name of Car Line.																				
A. M. 12.30	61	73	74	39	15	54	54	23	107	37	63	24	44	33	....	31	732	111	118	229	961
1.00	63	61	20	77	36	21	62	36	151	71	89	38	27	16	....	22	790	45	81	126	916
1.30	24	54	74	21	39	25	20	....	72	29	43	4	26	17	....	12	460	51	57	108	568
2.00	8	23	6	42	25	9	13	....	19	58	13	....	24	22	....	....	262	34	23	57	319
2.30	5	33	20	14	....	18	9	....	29	15	30	....	18	....	....	....	191	28	11	39	230
3.00	30	25	13	25	....	16	9	....	....	13	27	....	....	....	....	....	158	17	27	44	202
3.30	15	9	26	30	....	10	4	....	15	....	....	...	10	....	....	....	119	12	23	35	154
4.00	5	13	35	8	....	5	10	....	14	7	10	....	....	....	....	....	107	10	17	27	134
4.30	43	8	11	13	...	25	6	....	9	....	6	....	....	....	....	....	121	6	5	11	132
5.00	26	6	8	6	....	7	4	....	30	7	6	....	....	....	....	....	100	4	8	12	112
5.30	7	3	10	3	....	9	11	....	....	....	....	....	39	...	....	....	82	4	57	61	143
6.00	5	7	1	11	1	....	29	....	52	4	50	....	12	....	8	....	180	7	53	60	240
6.30	25	11	23	18	18	12	102	21	170	31	31	29	12	14	37	....	554	20	72	92	646
7.00	26	19	34	55	10	58	55	16	181	47	41	31	23	18	19	....	633	54	60	114	747
7.30	74	31	28	48	3	54	89	26	248	57	69	37	46	38	30	....	878	65	90	155	1,033

TIME	Name of Car Line.																				Grand Total Surface Lines.
	Fulton Avenue.	Putnam Avenue.	Gates Avenue.	Myrtle Avenue.	Ralph Avenue.	Flatbush Avenue.	Third Avenue.	Court Street.	Graham Avenue	Flushing Avenue.	Seventh Avenue.	Park Avenue.	Bergen Street.	Vanderbilt Ave.	Flushing-Knick.	Douglass Street.	Total B.H.R.R. Lines.	DeKalb Avenue.	Smith Street.	Total C.I.& B.R. Lines.	
A. M.																					
8.00	114	16	66	43	....	59	61	25	141	37	15	14	39	29	27	....	686	95	49	144	830
8.30	70	44	68	43	....	87	31	54	160	21	19	35	41	19	15	....	707	109	68	177	884
9.00	91	40	118	70	3	54	84	44	108	66	23	11	43	36	25	....	816	61	40	101	917
9.30	194	26	103	79	4	96	65	61	136	56	77	68	58	27	32	....	1,082	115	91	206	1,288
10.00	121	73	168	48	16	58	81	88	156	22	76	26	36	21	10	....	1,000	132	61	193	1,193
10.30	132	67	175	91	20	88	85	71	136	38	52	36	62	32	43	....	1,128	86	74	160	1,288
11.00	109	45	92	55	19	100	106	68	162	55	46	37	77	40	16	....	1,027	141	97	238	1,265
11.30	106	119	251	59	103	124	95	82	212	20	78	41	70	64	22	....	1,446	124	91	214	1,661
12.00 M....	88	57	146	100	37	48	64	53	97	53	31	23	56	21	1	....	875	97	41	138	1,013
P. M.																					
12.30	92	62	242	69	36	119	97	81	177	65	35	74	41	55	....	....	1,245	192	82	274	1,519
1.00	99	83	165	59	21	88	92	98	120	37	76	56	40	33	....	....	1,067	73	86	159	1,226
1.30	224	81	229	61	35	69	86	73	194	61	78	32	66	31	....	....	1,320	118	96	214	1,534
2.00	169	138	278	78	24	134	95	66	165	94	62	65	78	62	....	....	1,508	95	113	208	1,716
2.30	133	82	214	71	30	122	135	59	62	37	58	24	55	32	25	....	1,139	153	115	268	1,407
3.00	166	67	215	74	38	116	89	98	202	26	108	70	86	50	41	....	1,446	129	118	247	1,693
3.30	127	126	283	93	30	91	47	79	149	58	95	50	101	46	44	....	1,419	213	201	414	1,833
4.00	236	141	363	127	103	153	146	116	156	50	172	103	155	98	51	....	2,170	152	129	281	2,451

4.30	199	173	333	266	40	269	162	139	272	70	229	58	188	160	47	....	2,605	253	234	487	3,092
5.00	314	202	301	153	21	191	182	225	237	75	138	171	203	85	104	....	2,602	341	168	509	3,111
5.30	600	178	626	494	....	276	167	298	545	250	278	416	293	526	87	....	5,034	625	570	1,195	6,229
6.00	357	485	602	545	....	304	145	547	1,200	600	402	614	339	468	162	....	6,770	738	536	1,274	8,044
6.30	313	287	450	652	....	266	174	337	1,176	283	596	463	475	303	316	....	6,091	510	621	1,131	7,222
7.00	188	155	399	133	67	215	195	216	325	159	213	285	308	109	215	....	3,183	424	297	721	3,904
7.30	83	156	218	134	56	142	109	38	250	58	66	201	197	75	....	....	1,783	229	184	413	2,196
8.00	192	101	165	114	22	88	90	104	206	74	166	103	140	70	....	....	1,635	150	195	345	1,980
8.30	76	48	114	34	45	89	75	66	211	124	102	139	112	47	....	....	1,282	147	130	277	1,559
9.00	60	71	80	40	106	47	49	34	186	51	43	69	60	33	....	....	929	70	57	127	1,056
9.30	67	80	58	46	36	57	44	24	180	57	29	61	118	24	...	....	881	116	118	234	1,115
10.00	63	106	90	109	30	42	29	69	67	82	68	38	76	65	....	....	934	114	126	240	1,174
10.30	61	65	110	31	17	54	34	49	91	48	58	59	83	78	....	....	838	91	102	193	1,031
11.00	54	78	78	70	28	50	27	22	91	41	42	24	49	9	....	....	663	60	65	125	788
11.30	52	51	54	15	20	50	36	35	43	68	30	31	32	40	....	....	557	51	99	150	707
12.00	73	104	114	137	49	54	56	64	132	68	60	51	76	83	....	....	1,121	51	114	165	1,286
Totals..	5,440	3,983	7,351	4,603	1,203	4,123	3,510	3,605	8,842	3,280	4,099	3,711	4,135	3,029	1,377	65	62,356	6,523	5,870	12,393	74,749

Brooklyn Bridge—Trolley Car Passengers to Manhattan.

Count of Passengers by Half Hours for Monday, October 26, 1903.

TIME.	Name of Car Line.																			Grand Total Surface Lines.
	Fulton Avenue.	Putnam Avenue.	Gates Avenue.	Myrtle Avenue.	Ralph Avenue.	Flatbush Avenue.	Third Avenue.	Court Street.	Graham Avenue.	Flushing Avenue.	Seventh Avenue.	Park Avenue.	Bergen Street.	Vanderbilt Avenue.	Flushing & Knickerbocker.	Douglass Street.	Total B. H. R. R. Lines.	DeKalb Avenue.	Smith Street.	Total C. I. & B. R. Lines.	
A. M.																					
12.30.......	44	23	31	14	23	36	44	30	36	2	22	44	10	9	..	8	376	46	48	94	470
1.00.......	11	27	35	27	13	9	11	6	38	1	23	11	11	7	..	19	249	35	43	78	327
1.30.......	29	23	34	16	6	12	11	39	23	12	7	1	4	1	..	22	240	19	34	53	293
2.00.......	9	9	15	11	13	3	10	..	30	10	8	..	3	..	..	..	121	9	31	40	161
2.30.......	18	14	11	33	..	7	7	..	..	10	4	..	24	..	..	..	128	29	29	58	186
3.00.......	55	7	9	15	..	12	4	..	19	6	1	..	..	..	..	..	128	6	6	12	140
3.30.......	6	68	6	19	..	2	7	..	12	..	3	..	4	..	..	..	127	14	9	23	150
4.00.......	1	10	17	13	..	10	..	..	10	7	6	..	..	..	..	..	74	10	9	19	93
4.30.......	9	5	5	26	..	3	27	..	32	..	5	..	..	..	..	..	112	12	4	16	128
5.00.......	12	20	7	13	..	1	4	..	94	17	10	..	..	..	..	..	178	14	27	41	219
5.30.......	16	32	5	45	..	25	23	..	37	..	18	40	..	..	..	..	241	18	60	78	319
6.00.......	23	8	36	14	31	17	78	..	215	61	10	44	49	..	18	..	604	42	97	139	743
6.30.......	33	52	37	129	33	59	122	10	350	47	129	82	92	45	156	..	1,376	117	137	254	1,630
7.00.......	167	132	59	335	112	80	169	121	915	199	181	345	241	200	302	..	3,558	445	386	831	4,389
7.30.......	145	328	363	709	..	323	396	250	887	266	333	604	307	309	403	..	5,623	610	460	1,070	6,693

8.00	524	383	468	359	..	401	299	337	1,242	443	440	371	458	383	292	..	6,405	613	548	1,161	7,566
8.30	190	246	274	160	..	420	155	52	769	173	501	229	462	290	197	..	4,118	280	382	662	4,780
9.00	233	321	543	382	..	301	243	281	607	193	445	222	453	347	137	..	4,708	689	407	1,096	5,804
9.30	233	264	223	150	13	392	218	151	314	97	272	174	299	139	59	..	3,018	467	224	691	3,709
10.00	158	116	289	127	51	178	186	127	292	62	144	52	132	116	11	..	2,041	352	205	557	2,598
10.30	109	78	199	113	52	162	158	126	133	..	68	81	112	54	54	..	1,499	193	84	277	1,776
11.00	105	163	292	68	75	250	103	102	151	116	122	82	94	73	20	..	1,816	286	56	342	2,158
11.30	110	86	183	85	21	146	107	66	186	54	71	34	76	47	17	..	1,289	242	186	428	1,717
12.00 M.	89	69	177	66	47	145	110	93	150	42	63	58	105	45	2	..	1,261	140	164	304	1,565
P. M.																					
12.30	53	76	150	59	41	119	143	51	171	81	39	87	61	27	..	..	1,158	130	85	215	1,373
1.00	132	46	128	45	27	114	144	140	181	25	47	28	65	10	..	..	1,132	160	75	235	1,367
1.30	84	107	226	42	33	143	60	77	231	48	86	46	84	36	..	..	1,303	88	128	216	1,519
2.00	83	80	248	78	66	134	174	62	206	74	12	52	66	73	..	..	1,408	204	127	331	1,739
2.30	72	80	172	81	42	157	122	104	97	15	140	60	61	59	59	..	1,321	188	129	317	1,638
3.00	106	90	200	77	56	90	73	88	212	53	80	70	93	34	41	..	1,363	189	77	266	1,629
3.30	112	63	247	102	20	122	63	101	138	13	66	60	65	23	61	..	1,256	116	121	237	1,493
4.00	62	82	187	56	41	98	108	47	166	39	52	45	68	39	36	..	1,126	133	78	211	1,337
4.30	71	55	146	61	14	89	98	82	209	74	49	50	77	37	43	..	1,155	151	69	220	1,375
5.00	101	76	148	56	8	97	72	115	154	44	117	42	51	44	34	..	1,159	93	53	146	1,305
5.30	99	110	101	90	..	97	37	59	337	185	277	44	100	46	65	..	1,647	85	87	172	1,819
6.00	82	45	49	61	..	78	141	81	359	66	201	55	48	47	152	..	1,465	75	142	217	1,682
6.30	42	37	87	61	..	113	68	44	125	37	64	37	42	17	10	..	784	49	90	139	923
7.00	49	39	98	56	24	40	81	25	140	34	54	36	50	32	16	..	774	63	106	169	943

TIME.	Name of Car Line.																		Grand Total Surface Lines.
	Fulton Avenue.	Putnam Avenue.	Gates Avenue.	Myrtle Avenue.	Ralph Avenue.	Flatbush Avenue.	Third Avenue.	Court Street.	Graham Avenue.	Flushing Avenue.	Seventh Avenue.	Park Avenue.	Bergen Street.	Vanderbilt Avenue.	Flushing & Knickerbocker.	Douglass Street.	Total B. H. R. R. Lines.	DeKalb Avenue.	Smith Street.	Total C. I. & B.R. Lines.	
P. M 7.30......	56	48	80	29	36	41	33	50	116	23	93	47	48	23	..	..	723	60	108	168	891
8.00.......	55	42	30	30	13	64	77	51	137	46	81	28	35	60	..	..	749	103	57	160	909
8.30.......	47	48	39	12	24	31	44	33	77	25	26	9	54	46	..	..	515	27	34	61	576
9.00.......	28	16	51	22	15	46	29	2	43	13	15	26	39	12	..	..	357	39	42	81	438
9.30.......	25	23	41	34	5	22	15	21	42	16	35	19	23	13	..	..	334	52	53	105	439
10.00.......	24	29	66	17	25	32	33	18	27	6	34	2	14	6	..	..	333	86	22	108	441
10.30.......	30	18	35	8	12	31	12	26	47	14	24	22	27	25	..	..	331	32	37	69	400
11.00... ..	50	20	23	40	9	23	5	25	14	8	19	13	26	20	..	..	295	47	40	87	382
11.30.......	16	41	65	18	30	32	49	24	33	37	8	5	10	12	..	..	380	31	65	96	476
12.00.......	4	54	24	70	27	20	64	8	33	13	34	1	33	37	..	..	422	75	40	115	537
Totals..	3,812	3,809	5,959	4,134	1,078	4,827	4,237	3,125	9,842	2,807	4,539	3,358	4,176	2,843	2,185	49	60,780	6,964	5,501	12,465	73,245

Brooklyn Bridge—Trolley Car Passengers to Brooklyn.

Count of Passengers by Half Hours for Monday, October 17, 1904.

TIME.	Fulton Ave.	Putnam Ave.	Gates Ave.	Myrtle Ave.	Ralph Ave.	Flatbush Ave.	Third Ave.	Court St.	Graham Ave.	Flushing Ave.	Seventh Ave.	Park Ave.	Bergen St.	Vanderbilt Ave.	Flushing-Knickerbocker Aves.	Douglass St.	Total B. H. R. R. Lines.	DeKalb Ave.	Smith St.	Total C. I. & B. R. Lines.	Grand Total Surface Lines:
NAME OF CAR LINE.																					
A. M. 12.30......	63	57	102	73	40	60	39	60	110	121	105	44	53	33	....	66	1,026	59	169	228	1,254
1.00......	43	59	68	31	33	29	29	17	157	72	47	16	29	36	....	10	676	58	112	170	846
1.30......	47	66	73	20	31	25	34	....	62	41	47	21	32	14	....	37	550	98	39	137	687
2.00......	41	9	20	19	15	15	20	....	33	44	27	....	20	12	....	...	275	30	47	77	352
2.30......	17	38	16	25	....	27	10	....	37	24	9	....	19	..	....	....	222	14	30	44	266
3.00......	20	35	11	29	....	12	11	....	21	14	34	....	....	....	....	....	187	23	29	52	239
3.30......	12	..	23	20	....	9	8	....	36	....	9	....	7	....	....	....	124	28	20	48	172
4.00......	17	24	6	5	....	10	9	....	31	9	....	....	....	....	....	....	111	16	18	34	145
4.30......	42	21	7	11	....	10	9	....	16	....	12	....	....	....	....	....	128	6	13	19	147
5.00......	21	....	8	22	....	5	5	....	19	9	....	....	....	....	....	....	89	8	25	33	122
5.30......	32	24	7	6	4	35	16	...	56	....	6	....	....	....	....	....	186	7	50	57	243
6.00......	37	7	15	7	....	17	39	....	54	12	19	4	19	....	6	....	236	22	118	140	376
6.30......	20	8	12	23	12	75	94	15	92	26	49	61	12	7	7	....	513	28	89	117	630

TIME.	Fulton Ave.	Putnam Ave.	Gates Ave.	Myrtle Ave.	Ralph Ave.	Flatbush Ave.	Third Ave.	Court St.	Graham Ave.	Flushing Ave.	Seventh Ave.	Park Ave.	Bergen St.	Vanderbilt Ave.	Flushing-Knickerbocker Aves.	Douglass St.	Total B. H. R. R. Lines.	DeKalb Ave.	Smith St.	Total C. I. & B. R. Lines.	Grand Total Surface Lines.
	Name of Car Line.																				
A. M. 7.00	25	23	29	40	3	39	68	12	110	68	47	67	41	9	19	....	600	49	84	133	733
7.30	120	50	46	67	....	23	77	32	219	75	105	55	56	42	40	....	1,007	68	71	139	1,146
8.00	75	48	77	46	....	70	25	33	183	26	22	38	41	29	83	....	796	106	56	162	958
8.30	88	54	63	22	....	67	36	61	69	13	52	32	42	12	49	....	660	106	35	141	801
9.00	170	56	125	66	....	75	74	36	75	28	82	62	25	12	42	....	928	107	71	178	1,106
9.30	124	69	114	44	2	116	54	32	114	17	51	49	73	28	27	....	914	117	79	196	1,110
10.00	90	97	123	68	5	141	51	51	154	63	75	63	53	21	33	....	1,088	208	114	322	1,410
10.30	188	95	121	126	8	126	47	38	70	35	111	35	58	18	55	....	1,131	118	69	187	1,318
11.00	232	78	203	56	6	100	62	56	195	57	76	52	59	37	11	....	1,290	155	74	229	1,519
11.30	131	103	204	64	25	144	60	104	144	24	77	34	70	45	51	....	1,280	195	95	290	1,570
12.00 M.	140	66	132	114	15	128	52	21	160	67	65	54	44	41	8	....	1,107	164	138	302	4,409
P. M. 12.30	182	97	199	103	14	96	43	55	148	85	84	59	78	48	....	....	1,291	231	130	361	1,652
1.00	87	92	210	77	2	161	90	65	195	58	92	70	57	37	...	....	1,293	194	88	282	1,575
1.30	204	84	129	64	5	107	50	46	143	27	97	44	122	33	....	....	1,155	167	124	291	1,446
2.00	223	184	207	122	11	115	73	100	219	61	115	81	107	49	....	....	1,667	173	168	341	2,008
2.30	204	94	216	63	8	104	58	47	92	59	169	55	130	67	30	....	1,396	193	143	336	1,732

3.00.......	237	125	224	89	12	145	71	108	161	67	126	43	78	26	62	....	1,580	234	138	372	1,952
3.30.......	148	150	298	130	13	183	92	72	144	39	141	109	75	51	75	....	1,720	207	156	363	2,083
4.00.......	220	154	280	140	8	173	88	110	178	34	121	122	128	74	80	....	1,910	349	163	512	2,422
4.30.......	312	141	310	158	36	350	88	127	206	93	238	148	168	120	82	....	2,577	362	265	627	3,204
5.00.......	232	202	508	201	15	238	70	175	337	89	229	157	181	119	31	....	2,784	463	284	747	3,531
5.30.......	608	301	590	441	....	369	178	345	628	233	546	408	304	256	214	....	5,421	682	583	1,265	6,686
6.00.......	590	359	615	470	....	252	234	558	1,069	455	558	567	575	577	259	....	7,138	947	505	1,452	8,590
6.30.......	339	418	729	626	54	306	165	388	885	578	634	631	465	415	361	....	7,014	695	661	1,356	8,370
7.00.......	339	173	350	299	28	338	88	223	531	199	261	485	315	259	162	....	4,050	416	343	759	4,809
7.30.......	233	130	240	132	34	167	81	109	375	149	128	208	84	107	....	....	2,177	287	229	516	2,693
8.00.......	67	128	158	139	22	90	70	64	327	62	47	143	134	49	....	....	1,500	146	163	309	1,809
8.30.......	87	60	148	60	8	77	48	51	162	50	160	109	82	39	....	....	1,141	128	127	255	1,396
9.00.......	72	63	90	105	3	84	33	61	228	91	134	78	72	45	....	....	1,159	123	129	252	1,411
9.30.......	69	99	104	89	16	90	46	55	178	73	25	57	45	27	....	....	973	119	160	279	1,252
10.00.......	84	108	112	52	15	66	40	29	114	88	91	76	104	43	....	....	1,022	51	144	195	1,217
10 30.......	42	95	90	39	16	63	42	51	107	70	77	72	58	64	....	....	885	115	100	215	1,100
11.00.......	97	85	78	52	23	70	21	47	87	34	75	27	44	40	....	....	780	89	118	207	987
11.30.......	49	48	103	50	34	83	30	36	119	16	59	23	54	55	....	....	759	84	117	201	960
12.00.......	96	97	79	36	21	80	42	45	96	53	66	43	60	34	....	....	848	112	117	229	1,077
Totals....	6,615	4,574	7,672	4,741	597	5,165	2,770	3,535	8,952	3,608	5,400	4,522	4,283	3,030	1,787	113	67,364	8,357	6,800	15,157	82,521

Brooklyn Bridge.

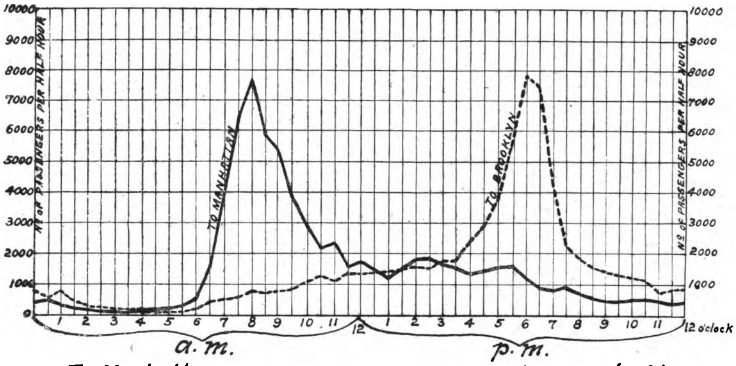
Trolley Car Passengers to Manhattan, Count of Passengers by Half Hours for Monday, October 17, 1904.

TIME.	Name of Car Line.																			Grand Total Surface Lines.
	Fulton Avenue.	Putnam Avenue.	Gates Avenue.	Myrtle Avenue.	Ralph Avenue.	Flatbush Avenue.	Third Avenue.	Court Street.	Graham Avenue.	Flushing Avenue.	Seventh Avenue.	Park Avenue.	Bergen Street.	Vanderbilt Avenue.	Flushing & Knickerbocker.	Douglass Street.	Total B. H. R. R. Lines.	De Kalb Avenue.	Smith Street.	Total C. I. & B. R. Lines.	
A. M. 12.30......	43	19	60	30	29	39	34	15	89	23	24	21	21	14	....	17	478	40	92	132	610
1.00......	15	20	41	12	14	3	11	3	53	14	13	8	13	4	....	24	248	11	27	38	286
1.30......	21	24	15	8	2	14	27	....	55	12	7	4	6	4	....	7	206	24	51	75	281
2.00......	37	10	29	19	6	12	9	....	48	5	3	....	15	....	....	....	193	31	47	78	271
2.30......	9	5	11	21	....	13	2	....	26	13	11	....	2	....	....	....	118	10	44	54	172
3.00......	4	7	10	14	....	5	3	....	30	7	4	....	....	....	....	....	84	....	19	19	103
3.30......	8	12	....	5	....	11	5	....	13	....	3	....	5	....	....	....	72	12	7	19	91
4.00......	5	17	30	11	....	3	....	....	11	5	4	....	....	....	....	....	86	....	13	13	99
4.30......	20	27	8	18	....	11	10	....	28	....	5	....	....	....	....	....	127	33	13	46	173
5.00......	26	....	13	....	....	....	9	....	26	21	11	....	....	....	....	....	106	7	29	36	142
5.30......	11	17	14	28	....	21	24	....	115	....	20	....	....	....	....	....	250	33	31	64	314
6.00......	36	43	34	36	28	9	56	....	152	27	22	49	23	28	48	....	591	....	160	160	751
6.30......	29	33	41	64	34	114	189	33	336	55	117	162	107	45	93	....	1,452	60	114	174	1,626
7.00......	196	172	172	328	94	184	205	82	734	182	146	452	126	226	200	....	3,499	283	419	702	4,201
7.30......	255	239	249	367	....	242	281	198	1,281	299	397	267	451	177	550	....	5,253	694	620	1,314	6,567

8.00......	290	339	559	605	....	296	359	363	1,082	343	426	463	331	320	301	....	6,077	603	422	1,025	7,102
8.30......	89	323	358	131	....	363	284	225	588	166	498	251	346	350	249	....	4,221	597	311	908	5,129
9.00......	315	294	520	312	22	427	171	242	584	114	600	351	435	258	271	....	4,916	523	497	1,020	5,936
9.30......	173	194	290	163	68	354	171	118	292	160	293	107	247	224	64	....	2,918	373	214	587	3,505
10.00......	95	185	298	88	26	298	148	109	243	80	191	50	92	101	77	....	2,081	328	240	568	2,649
10.30......	163	189	268	94	59	173	153	167	189	39	128	68	112	198	68	....	2,068	282	155	437	2,505
11.00......	171	84	222	104	46	137	177	109	217	49	104	44	78	82	27	....	1,651	264	152	416	2,067
11.30......	85	122	198	89	42	158	140	55	167	56	59	53	58	14	47	....	1,343	361	143	504	1,847
12.00 M....	44	46	114	26	21	66	71	35	69	49	67	32	54	37	7	....	738	149	50	199	937
P. M.																					
12.30......	156	88	296	72	54	161	114	81	235	117	87	42	123	57	....	....	1,683	273	173	446	2,129
1.00......	119	75	132	56	26	68	120	59	158	65	85	15	40	38	....	....	1,056	236	103	339	1,395
1.30......	93	69	142	79	40	132	139	100	231	43	73	56	93	114	....	....	1,404	187	142	329	1,733
2.00......	178	141	209	83	48	162	101	76	179	52	87	35	72	84	....	....	1,507	304	135	439	1,946
2.30......	162	84	240	60	28	90	115	59	203	57	67	65	95	72	71	....	1,448	315	154	469	1,917
3.00......	98	76	196	71	36	113	153	11	136	34	105	50	55	71	45	....	1,250	208	89	297	1,547
3.30......	48	71	168	45	31	110	116	72	131	50	92	69	93	36	70	....	1,202	248	124	372	1,574
4.00......	72	76	178	105	25	83	106	92	216	42	73	20	68	89	67	....	1,312	188	132	320	1,632
4.30......	100	79	114	63	17	153	62	71	120	75	75	59	69	19	90	....	1,166	166	67	233	1,399
5.00......	125	65	120	75	7	71	49	75	152	68	84	37	58	84	33	....	1,103	220	171	391	1,494
5.30......	137	40	117	87	....	81	41	115	314	119	151	52	103	111	97	....	1,565	136	126	262	1,827
6.00......	137	57	93	79	...	63	141	104	204	40	99	93	86	51	41	....	1,288	156	152	308	1,596
6.30......	40	85	145	42	16	84	72	54	161	92	85	25	75	43	51	....	1,070	97	295	392	1,462
7.00......	65	27	63	32	8	89	21	75	144	35	41	25	54	46	27	....	752	72	68	140	892

TIME.	Fulton Avenue.	Putnam Avenue.	Gates Avenue.	Myrtle Avenue.	Ralph Avenue.	Flatbush Avenue.	Third Avenue.	Court Street.	Graham Avenue.	Flushing Avenue.	Seventh Avenue.	Park Avenue.	Bergen Street.	Vanderbilt Avenue.	Flushing & Knickerbocker.	Douglass Street.	Total B. H. R. R. Lines.	DeKalb Avenue.	Smith Street.	Total C. I. & B. R. Lines.	Grand Total Surface Lines.
P. M. 7.30......	65	11	105	43	20	72	48	32	127	38	32	78	107	38	....	....	816	95	131	226	1,042
8.00......	37	31	125	56	32	72	34	79	169	47	25	17	76	32	....	....	833	75	105	180	1,012
8.30......	18	51	45	19	25	67	47	19	49	24	81	66	47	30	....	....	588	69	58	127	715
9.00......	32	33	58	25	10	31	21	34	98	24	13	32	18	27	....	....	456	28	53	81	537
9.30......	16	27	56	32	9	34	27	22	63	28	8	21	24	13	....	....	380	60	34	94	474
10.00......	20	37	45	29	10	19	22	26	63	21	32	27	39	38	....	....	428	43	76	119	547
10.30......	23	25	49	26	22	22	32	15	53	30	10	20	33	6	....	....	366	43	34	77	443
11.00......	38	22	35	13	19	27	22	15	75	3	31	16	39	25	....	....	380	52	58	110	490
11.30......	32	47	57	25	7	31	33	17	52	11	15	7	22	9	...	....	365	37	74	111	476
12.00......	24	28	21	6	7	23	19	23	23	7	15	7	27	18	....	....	248	53	30	83	331
Totals...	3,975	3,766	6,363	3,806	988	4,816	4,194	3,060	9,784	2,841	4,619	3,316	4,038	3,233	2,594	48	61,441	8,079	6,454	14,533	75,974

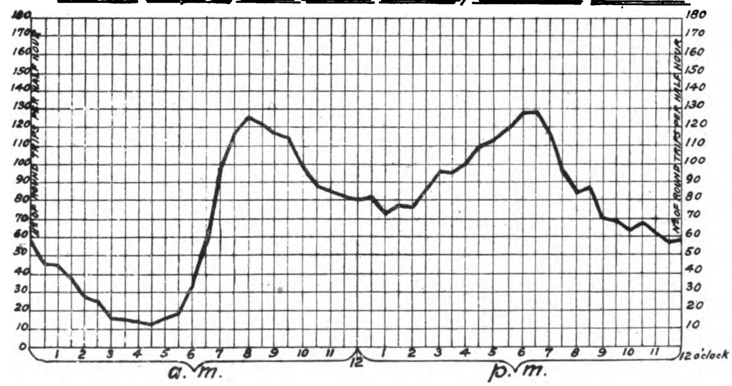
Diagram showing Passenger Travel by half hours in Trolley Cars - Monday, November 10-1902.



To Manhattan 74852
To Brooklyn 72808
Total both ways 147660

Maximum per half hour
To Manhattan 7743
To Brooklyn 7846

Diagram showing Trolley Car Service Round Trips by half hours - Monday. November 10. 1902.



Highest number of Cars per half hour 129
Lowest " " " " " " 12

4830
B.G.L. Dec. 24/02

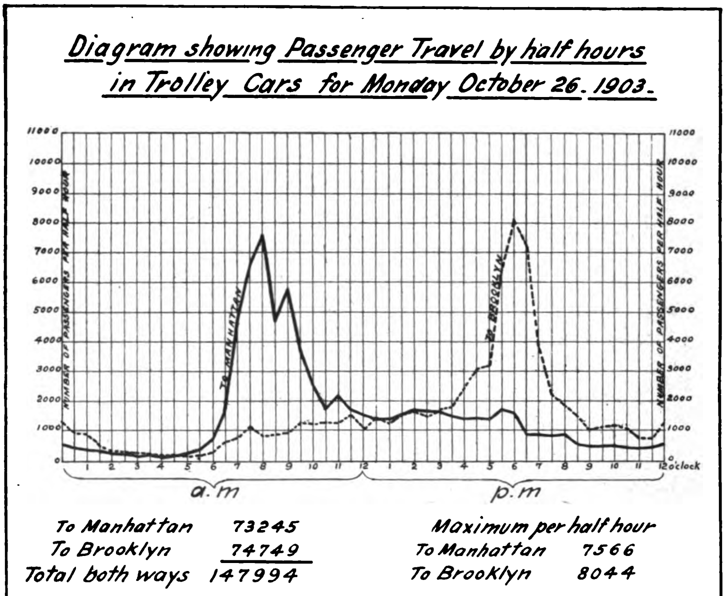


Diagram showing Passenger Travel by half hours
in Trolley Cars for Monday October 26. 1903.
Number of passengers per half hour
To Manhattan
To Brooklyn
o'clock
a.m
p.m
To Manhattan 73245
To Brooklyn 74749
Total both ways 147994
Maximum per half hour
To Manhattan 7566
To Brooklyn 8044

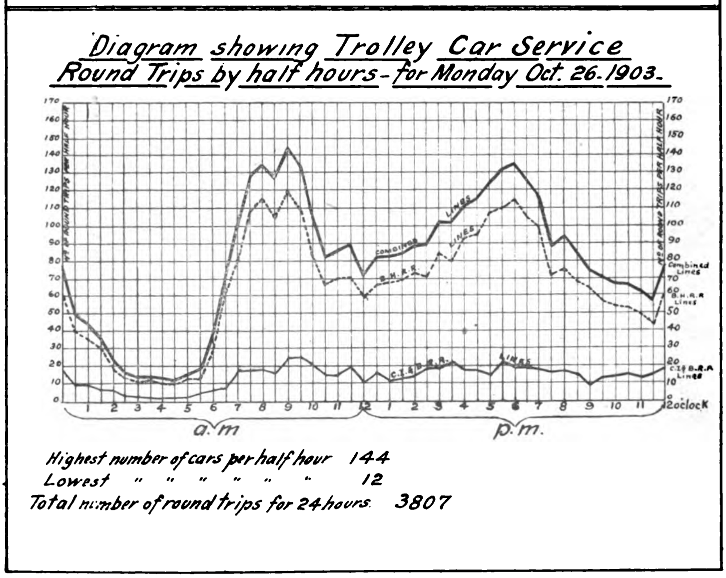
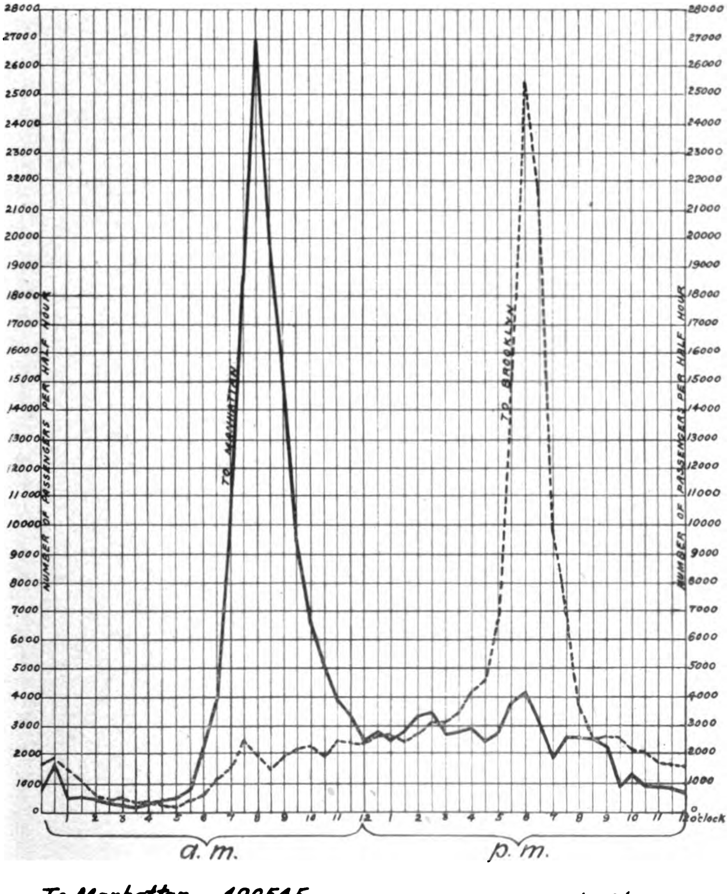


Diagram showing Trolley Car Service
Round Trips by half hours - for Monday Oct. 26. 1903.
Combined Lines
B.H.R.R. Lines
C.I. & B.R.R. Lines
o'clock
a.m
p.m.
Highest number of cars per half hour 144
Lowest " " " " " " 12
Total number of round trips for 24 hours 3807

Diagram showing Combined Passenger Travel by half hours on the Bridge Railway and Trolleys for Monday Oct. 17. 1904.



To Manhattan 190545
To Brooklyn 166431
Total both ways. 356976

Maximum per half hour
To Manhattan 26991
To Brooklyn 25356

Trolley Car Round Trips on the Brooklyn Bridge for Twelve Months ending December 31, 1902
[*Total Number of Trips in each Month*].

Name of Car Line.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Totals.
Fulton Avenue....................	7,703	6,505	7,692	7,121	7,297	7,100	7,202	6,800	5,290	5,730	6,118	6,642	81,200
Putnam Avenue....................	6,946	6,000	6,980	6,342	6,267	6,080	5,806	5,089	3,942	4,462	4,928	5,619	68,461
Gates Avenue.....................	7,832	6,538	7,574	6,940	6,822	6,783	6,577	6,145	4,788	5,312	8,025	9,773	83,109
Myrtle Avenue....................	5,569	4,733	5,366	5,333	5,500	5,419	5,755	5,521	4,483	4,939	5,310	5,634	63,562
Ralph Avenue.....................	4,293	3,476	4,208	4,131	4,277	4,174	4,334	4,291	3,572	3,832	4,026	4,166	48,780
Flatbush Avenue..................	7,355	6,528	7,644	7,569	7,873	7,396	6,800	6,695	5,497	6,143	6,289	6,484	82,273
Third Avenue.....................	6,780	5,425	6,587	6,653	6,866	6,956	7,498	6,962	5,641	5,846	6,246	6,062	77,522
Court Street.....................	4,896	4,012	4,817	4,746	5,410	5,645	6,360	6,180	4,439	3,981	4,004	4,132	58,622
Graham Avenue....................	9,815	7,675	9,808	9,020	8,884	8,622	8,887	8,679	7,519	8,349	8,719	9,141	105,118
Flushing Avenue..................	5,206	3,842	5,124	4,775	4,906	4,792	5,053	4,969	4,142	4,537	4,576	4,730	56,652
Brighton Beach...................	......	......	......	......	280	2,728	5,916	4,613	2,050	......	......	.....	15,587
Fifth Avenue.....................	7,572	6,457	2,135	......	......	......	18	......	.....	......	......	......	16,182
Seventh Avenue...................	6,571	5,541	7,046	6,284	6,508	6,095	6,100	5,585	4,595	5,182	5,458	5,884	70,851
Park Avenue......................	5,094	3,840	5,058	4,944	5,211	4,976	5,117	5,136	4,484	4,766	4,736	4,998	58,360
Bergen Street....................	5,827	4,888	6,422	6,293	6,439	6,198	6,256	6,156	5,301	5,682	5,780	6,233	71,475
Vanderbilt Avenue................	6,502	5,327	6,635	6,472	7,119	7,120	7,881	7,656	6,010	6,068	6,290	6,334	79,417
Douglass Street..................	539	416	533	431	610	591	623	600	511	399	716	494	6,463
Specials.........................	59	67	57	63	128	401	596	576	436	94	39	51	2,567
DeKalb Avenue....................	9,558	8,233	9,368	9,253	9,415	9,164	9,568	9,349	7,935	8,579	8,868	9,456	108,726
Smith Street.....................	9,357	7,738	9,069	9,384	10,960	11,549	13,196	11,997	8,889	9,151	9,616	9,689	120,595
Totals...........................	117,474	97,241	112,125	105,734	110 772	111,789	119,546	112,999	89,524	93,052	99,744	105,522	1,275,522

Daily Average Round Trips.. 3,495

Trolley Car Service on the Brooklyn Bridge for 1902 (Average Number of Round Trips in One Day in Each Month).

Name of Car Line.	Week Days.												Sundays.											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov	Dec.
Fulton Avenue	267	239	257	244	240	245	238	225	186	193	224	224	192	192	202	194	207	196	195	192	116	128	105	146
Putnam Avenue	230	234	224	213	208	212	192	165	131	147	176	186	241	211	221	201	162	158	155	159	106	124	104	149
Gates Avenue	263	242	244	230	214	223	208	195	199	170	287	330	250	232	245	241	260	244	242	215	152	180	170	218
Myrtle Avenue	187	166	172	178	176	181	185	177	153	161	186	183	179	186	181	174	188	181	192	182	126	147	133	170
Ralph Avenue	148	126	140	141	141	145	144	143	124	127	143	138	112	111	113	114	114	112	114	114	89	101	89	108
Flatbush Avenue	253	240	256	257	256	251	219	217	190	206	225	217	192	192	198	224	240	226	221	212	141	145	133	154
Third Avenue	231	195	214	224	226	200	247	224	193	192	222	199	196	186	204	206	191	195	208	226	157	164	141	175
Court Street	171	149	164	165	176	191	206	201	155	134	145	138	110	110	111	113	167	172	199	190	103	89	78	98
Graham Avenue	346	286	336	313	295	304	300	296	267	285	322	311	208	204	214	217	227	207	195	198	143	161	135	184
Flushing Avenue	185	145	177	168	163	167	165	163	147	156	169	162	99	89	107	103	126	125	146	146	82	81	71	88
Brighton Beach	...	...	...	...	74	140	187	139	143	...	...	...	...	...	...	...	52	96	215	198	112	...	...	...
Fifth Avenue	263	239	220	...	...	...	18	...	...	...	...	...	181	180	186	...	...	...	...	...	...	...	...	...
Seventh Avenue	225	201	234	214	212	206	198	183	160	173	196	196	180	181	192	182	193	190	185	163	109	126	114	145
Park Avenue	180	143	174	174	175	175	171	174	158	162	172	170	102	101	108	105	119	121	125	122	96	95	87	101
Bergen Street	201	179	217	218	215	217	209	208	186	191	207	210	150	150	158	158	161	155	151	148	116	131	119	137
Vanderbilt Avenue	222	192	217	217	228	235	245	236	206	203	223	212	184	179	198	205	239	251	314	306	163	144	144	151
Douglass Street	23	4	9	5	25	5	24	5	43	5	30	19	101	98	98	103	115	113	120	116	95	96	94	95
Specials	2	1	2	2	6	13	18	17	14	4	6	2	8	8	8	11	12	17	26	25	17	6	2	7
De Kalb Avenue	331	306	316	319	313	325	323	319	281	292	321	317	236	221	228	235	241	210	209	209	154	174	169	227
Smith Street	320	281	297	305	343	377	421	381	303	305	348	324	258	246	270	363	426	423	456	416	255	227	185	235

NOTE.—Averages for Brighton Beach and Fifth Avenue Lines based on a portion only of the month.

Trolley Car Round Trips on the Brooklyn Bridge for Twelve Months ending December 31, 1903 (*Total Number of Round Trips in Each Month*).

Name of Car Line.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals.
Fulton Avenue	6,928	5,909	6,296	6,533	6,888	6,293	6,100	5,913	5,361	6,165	6,284	7,130	75,800
Putnam Avenue	5,817	4,961	5,196	5,746	6,036	5,519	5,144	4,846	4,366	4,298	5,506	6,052	63,487
Gates Avenue	10,149	8,860	9,965	10,666	10,981	9,790	8,755	8,064	7,878	9,528	9,575	10,570	114,781
Myrtle Avenue	5,604	4,816	5,789	7,144	7,462	7,181	7,240	7,003	6,406	7,153	6,942	7,376	81,116
Ralph Avenue	4,190	3,630	3,173	3,367	3,562	3,236	3,077	3,012	2,686	3,050	3,074	3,239	39,296
Flatbush Avenue	7,293	6,298	6,937	7,387	7,650	6,494	5,719	6,078	5,692	6,492	6,547	7,301	79,888
Third Avenue	6,557	5,530	5,929	6,540	7,405	6,902	7,151	7,078	6,092	7,482	6,479	7,000	80,145
Court Street	4,537	3,977	4,543	4,702	5,633	4,970	5,714	5,119	4,815	5,577	5,417	5,692	60,696
Graham Avenue	9,756	8,428	9,788	10,363	10,778	9,798	9,285	8,986	8,018	9,286	9,335	10,160	113,981
Flushing Avenue	4,862	4,179	5,721	6,005	6,287	6,029	6,295	6,097	5,531	5,969	5,514	6,017	68,506
Seventh Avenue	6,056	5,220	5,462	5,778	5,954	5,655	5,456	5,182	4,828	5,579	5,481	5,960	66,611
Park Avenue	5,172	4,734	5,739	5,969	6,145	5,248	4,752	4,625	4,341	4,839	4,830	5,141	61,535
Bergen Street	6,199	5,394	5,853	6,139	6,344	5,965	6,059	5,951	5,473	6,080	5,921	6,436	71,814
Vanderbilt Avenue	6,372	5,344	5,937	6,448	7,055	5,991	6,801	6,188	5,196	5,418	5,573	5,823	72,146
Douglass Street	521	547	596	539	887	623	820	718	682	442	825	539	7,739
Specials	52	44	58	49	73	310	506	480	318	298	67	49	2,304
Brighton Beach	......	......	38	181	342	1,955	4,661	3,602	1,647	220	......	......	12,646
DeKalb Avenue	9,623	8,438	8,850	9,322	9,578	9,379	9,372	9,291	8,431	9,426	9,194	9,968	110,872
Smith Street	9,241	7,772	8,268	9,072	11,161	10,906	11,135	10,457	8,819	9,277	9,425	10,212	115,745
Totals	108,929	94,081	105,138	111,950	120,221	112,244	114,042	108,690	96,580	106,579	105,989	114,665	1,299,108

Daily Average Round Trips 3,559

Trolley Car Service on the Brooklyn Bridge for 1903 (Average Number of Round Trips, in One Day, in Each Month).

Name of Car Line.	Week Days.												Sundays.											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Fulton Avenue	235	220	211	225	232	219	204	161	187	212	224	241	148	156	163	173	171	150	147	132	123	109	136	154
Putnam Avenue	192	180	170	195	200	187	168	162	150	140	186	200	158	160	154	171	172	165	150	128	113	128	169	165
Gates Avenue	342	329	336	362	367	341	294	271	270	323	333	353	229	238	246	314	288	234	202	202	217	202	251	262
Myrtle Avenue	182	171	227	245	250	249	240	233	220	243	242	247	174	178	177	194	190	177	188	187	169	148	181	177
Ralph Avenue	139	133	102	112	115	107	98	97	89	101	103	105	112	112	107	116	113	111	105	101	94	81	99	98
Flatbush Avenue	242	231	230	251	252	216	188	201	194	221	231	244	186	187	191	217	220	220	158	171	161	132	156	175
Third Avenue	216	200	194	218	238	231	224	225	203	252	220	230	181	182	178	220	245	226	273	246	201	169	195	194
Court Street	152	147	152	159	169	158	163	161	165	191	192	193	105	109	120	143	249	215	330	189	132	106	124	118
Graham Avenue	334	320	334	359	362	339	305	300	275	315	327	342	182	186	221	258	273	248	254	236	219	198	230	234
Flushing Avenue	166	158	201	135	213	211	206	206	194	208	200	208	94	98	99	121	148	138	186	151	120	88	101	102
Seventh Avenue	202	191	182	198	200	194	182	175	167	188	189	198	150	157	144	158	151	154	135	125	123	127	149	151
Park Avenue	176	179	198	210	210	181	160	159	152	167	173	176	102	107	119	130	136	133	107	99	94	80	100	100
Bergen Street	208	200	195	209	211	206	202	200	189	206	205	215	145	148	157	174	169	154	151	150	142	130	162	156
Vanderbilt Avenue	211	196	195	208	215	194	196	185	168	177	187	191	167	160	172	261	295	237	374	276	205	158	177	167
Douglass Street	23	28	5	5	34	22	36	5	29	5	28	22	96	102	114	119	129	122	160	139	134	104	114	101
Specials	2	2	1	2	3	10	15	14	10	11	2	3	7	5	6	6	6	12	24	24	15	6	6	6
Brighton Beach	..	..	..	..	72	106	146	106	87	17	..	..	..	..	8	45	54	119	179	171	85	19	..	..
De Kalb Avenue	322	311	297	321	321	323	311	310	290	319	318	333	233	241	223	244	245	247	242	248	224	201	248	245
Smith Street	306	285	268	298	352	361	352	288	288	309	316	339	242	234	260	331	401	375	407	393	335	236	305	265

Trolley Car Round Trips on the Brooklyn Bridge for Twelve Months ending December 31, 1904, Total Number of Trips in Each Month.

Name of Car Line.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Totals.
Fulton Avenue	5,979	5,863	6,720	6,607	6,882	6,000	6,045	6,664	6,442	6,604	6,093	6,168	76,067
Putnam Avenue	5,749	5,699	6,193	5,863	5,891	5,653	5,271	5,956	5,645	5,777	5,345	5,851	68,893
Gates Avenue	9,818	10,092	11,023	10,345	10,483	9,562	9,193	9,942	9,513	10,070	9,987	10,258	120,286
Myrtle Avenue	7,007	6,659	7,326	6,862	6,792	6,832	6,831	7,387	7,114	7,257	6,799	7,020	83,886
Ralph Avenue	3,022	2,963	3,186	2,878	2,871	2,832	2,810	3,087	2,974	3,013	2,787	2,830	35,253
Flatbush Avenue	6,583	6,464	7,338	6,899	7,026	6,654	6,286	6,705	6,613	6,739	6,199	6,260	79,766
Third Avenue	6,102	6,103	6,675	6,473	6,628	6,737	6,480	6,977	6,576	6,613	5,743	5,521	76,628
Court Street	4,935	5,170	5,972	5,729	5,731	5,530	5,465	5,708	5,606	5,852	5,607	5,610	66,915
Graham Avenue	8,942	8,740	9,935	9,380	9,553	9,128	9,196	9,729	9,524	9,829	9,218	9,008	112,182
Flushing Avenue	5,261	5,337	6,199	6,075	6,244	6,035	6,019	6,457	6,326	6,358	5,708	5,394	71,413
Seventh Avenue	5,758	6,050	6,672	6,386	6,328	6,027	5,432	5,865	5,651	6,076	5,762	5,942	71,949
Park Avenue	4,143	4,137	4,924	4,814	4,962	5,000	4,918	5,159	4,877	5,194	4,878	4,802	57,808
Bergen Street	6,191	6,161	6,721	6,414	6,454	6,396	6,032	6,432	6,080	6,268	5,844	6,118	75,111
Vanderbilt Avenue	5,016	5,068	5,677	6,018	6,790	6,668	6,348	6,742	6,437	6,038	5,720	5,657	72,179
Douglass Street	624	533	430	453	872	725	919	682	717	608	725	3,074	10,362
Specials	288	179	177	116	108	124	131	93	72	103	86	194	1,671
Brighton Beach	......	....	......	84	509	2,640	4,009	3,292	2,004	....	....	......	12,538
DeKalb Avenue	9,229	9,122	9,896	9,372	9,454	9,472	9,237	10,051	9,663	9,839	9,482	9,992	114,809
Smith Street	8,998	8,674	9,123	9,059	10,615	11,336	11,638	11,513	10,824	10,022	8,794	9,055	119,651
Totals	103,645	103,014	114,187	109,827	114,193	113,351	112,260	118,441	112,658	112,260	104,777	108,754	1,327,367

Daily Average Round Trips 3,637

Trolley Car Service on the Brooklyn Bridge for 1904 *(Average Number of Round Trips in One Day in Each Month).*

Name of Car Line.	Weekdays.												Sundays.											
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Fulton Avenue	193	209	224	231	232	204	202	222	221	222	209	207	159	159	168	148	169	174	158	170	175	165	163	171
Putnam Avenue	189	202	204	204	193	191	171	195	191	191	180	192	166	165	171	140	174	173	164	170	169	160	166	167
Gates Avenue	329	363	369	361	352	329	306	331	327	341	347	343	254	255	263	242	265	251	245	250	254	241	242	248
Myrtle Avenue	235	239	244	238	227	234	227	246	245	245	233	232	180	172	183	165	179	186	184	189	186	178	182	190
Ralph Avenue	98	103	104	97	92	94	89	99	99	97	92	90	95	98	98	89	98	99	100	100	101	96	99	99
Flatbush Avenue	218	230	242	237	234	228	205	219	226	228	213	207	180	178	198	182	201	181	193	195	185	163	163	171
Third Avenue	198	214	219	221	214	219	213	228	220	218	191	176	188	186	192	179	215	260	190	202	212	188	192	189
Court Street	167	187	201	201	184	180	172	182	190	202	197	190	119	121	133	124	189	213	198	198	168	119	120	120
Graham Avenue	300	313	337	328	321	314	309	326	328	334	319	298	231	227	231	211	243	244	235	234	247	227	229	239
Flushing Avenue	184	197	214	219	210	204	199	212	217	221	201	183	98	101	103	96	155	182	167	186	171	122	120	114
Seventh Avenue	192	218	225	225	214	208	180	195	193	204	198	197	153	150	152	132	153	153	152	151	158	152	153	157
Park Avenue	141	150	168	171	170	176	169	176	172	181	172	163	94	96	99	89	108	107	105	100	100	96	99	98
Bergen Street	208	221	225	223	217	220	200	214	210	210	201	204	154	156	158	156	165	169	166	164	155	159	156	154
Vanderbilt Avenue	160	176	185	198	205	205	194	210	213	197	193	184	171	166	173	215	294	336	259	268	224	181	176	172
Douglass Street	21	23	5	5	39	7	36	7	34	7	34	96	99	99	103	109	135	174	148	162	137	115	113	121
Specials	9	5	5	3	2	4	4	8	3	3	2	6	13	12	11	7	9	6	7	8	5	6	8	9
Brighton Beach	..	..	..	..	9	79	124	96	90	..	..	..	..	..	..	21	55	146	156	173	119	..	..	..
DeKalb Avenue	308	325	330	325	316	326	287	335	333	332	326	333	243	246	248	229	250	250	353	252	251	241	249	251
Smith Street	295	306	298	306	336	367	368	370	362	330	296	298	244	257	269	276	378	448	416	380	354	290	273	251

CARRIAGEWAYS.

Beginning with the installation of the surface car tracks upon the carriageways of the Bridge, during the spring of 1898, there has been each year a steady falling off in the receipts from vehicular traffic, the constant proximity of the cars and the increased liability of risk of collision having forced the drivers of light vehicles to avoid the Bridge.

The following statement shows the total receipts each year from 1889 to 1904, inclusive, and clearly indicates that the falling off in receipts began with the introduction of the surface car service on the Bridge:

Receipts from Carriageways.

1889	$70,034 34
1890	76,192 50
1891	80,592 02
1892	83,468 36
1893	83,347 10
1894	87,426 16
1895	94,196 89
1896	88,554 63
1897	91,066 09
1898	83,813 14
1899	82,759 92
1900	81,278 77
1901	79,648 63
1902	76,492 08
1903	77,796 64
1904	73,809 73

The following tables show:

The vehicular traffic over the Bridge by months during the years 1902, 1903 and 1904; also the vehicular and promenade traffic by half hours for an ordinary day, as per counts taken November 10, 1902, October 26, 1903, and October 17, 1904:

CARRIAGEWAY TRAFFIC—BY MONTHS.

	From Manhattan.		From Brooklyn.	
	Led Horses.	Vehicles.	Led Horses.	Vehicles.
1902.				
January	444	42,243	1,020	45,609
February	824	37,373	1,187	38,062
March	893	47,828	1,167	49,509
April	894	49,618	1,164	51,706
May	1,251	50,954	1,736	54,261
June	932	47,243	1,700	50,806
July	1,046	45,266	1,403	48,824
August	1,004	45,460	1,317	48,550
September	874	46,474	1,267	50,249
October	914	50,377	1,466	53,533
November	896	46,384	1,488	48,949
December	892	44,249	1,197	45,463
	10,864	553,469	16,112	585,521
1903.				
January	879	46,004	1,118	47,197
February	889	39,821	1,201	40,616
March	883	49,889	1,181	51,710
April	780	50,244	1,086	52,865
May	1,366	49,183	1,457	52,928
June	733	48,032	1,096	52,604
July	814	45,202	1,187	49,626
August	699	44,071	1,113	48,157
September	903	46,434	1,304	50,857
October	854	50,453	1,259	53,958
November	947	45,946	1,214	48,230
December	841	46,517	1,119	47,712
	10,588	561.796	14.335	596,460

	From Manhattan.		From Brooklyn.	
	Led Horses.	Vehicles.	Led Horses.	Vehicles.
1904.				
January	1,245	38,084	1,506	38,516
February	892	40,588	1,071	40,932
March	596	47,073	931	48,624
April	548	47,251	789	49,392
May	465	46,748	756	50,459
June	424	45,181	845	49,517
July	431	41,096	823	44,741
August	408	42,683	789	46,864
September	452	43,002	819	47,716
October	649	45,467	817	48,894
November	531	43,875	900	46,341
December	844	42,157	1,315	43,780
	7,485	523,205	11,361	555,776

Brooklyn Bridge.

Carriageway Traffic by Half Hours for November 10, 1902.

Time.	To Manhattan.			To Brooklyn.			Total Vehicles.		Receipts.		Total Receipts.
	Singles.	Doubles.	Led Horses.	Singles.	Doubles.	Led Horses.	Singles.	Doubles.	To Manhattan.	To Brooklyn.	
12.30 A.M..	2	2	..	4	6	2	6	8	$0 30	$0 86	$1 16
1.00 " ..	5	1	..	1	13	9	6	14	35	1 62	1 97
1.30 " ..	1	..	..	3	4	1	4	4	5	58	63
2.00 " ..	6	..	..	8	2	..	14	2	30	60	90
2.30 " ..	19	6	..	2	3	2	21	9	1 55	46	2 01
3.00 " ..	1	2	..	1	1	..	2	3	25	15	40
3.30 " ..	10	4	..	..	2	..	10	6	90	20	1 10
4.00 " ..	7	8	..	2	..	..	9	8	1 15	10	1 25
4.30 " ..	13	8	..	4	3	..	17	11	1 45	50	1 95
5.00 " ..	7	10	..	11	3	..	18	13	1 35	85	2 20
5.30 " ..	12	5	..	23	1	..	35	6	1 10	1 25	2 35
6.00 " ..	19	10	..	1	1	..	20	11	1 95	15	2 10
6.30 " ..	15	17	6	2	2	..	17	19	2 63	30	2 93
7.00 " ..	30	22	..	4	2	..	34	24	3 70	40	4 10
7.30 " ..	55	35	..	14	6	..	69	41	6 25	1 30	7 55
8.00 " ..	56	47	..	13	4	..	69	51	7 50	1 05	8 55
8.30 " ..	100	38	..	22	13	..	122	51	8 80	2 40	11 20
9.00 " ..	75	21	1	20	7	..	95	28	5 88	1 70	7 58
9.30 " ..	49	23	..	33	18	2	82	41	4 75	3 51	8 26
10.00 " ..	51	24	..	43	19	..	94	43	4 95	4 05	9 00
10.30 " ..	50	20	2	47	14	..	97	34	4 56	3 75	8 31
11.00 " ..	48	17	4	34	13	2	82	30	4 22	3 06	7 28
11.30 " ..	53	21	2	51	13	..	104	34	4 81	3 85	8 66
12.00 M	53	14	..	50	3	1	103	17	4 05	2 83	6 88
12.30 P.M..	35	14	..	40	17	..	75	31	3 15	3 70	6 85
1.00 " ..	32	22	..	21	9	..	53	31	3 80	1 95	5 75
1.30 " ..	48	17	..	34	14	..	82	31	4 10	3 10	7 20
2.00 " ..	45	25	..	42	15	4	87	40	4 75	3 72	8 47
2.30 " ..	52	29	..	48	11	..	100	40	5 50	3 50	9 00
3.00 " ..	40	15	..	41	15	..	81	30	3 50	3 55	7 05
3.30 " ..	58	22	..	36	14	..	94	36	5 10	3 20	8 30
4.00 " ..	33	14	..	64	14	..	97	28	3 05	4 60	7 65

Time.	To Manhattan.			To Brooklyn.			Total Vehicles.		Receipts.		Total Receipts.
	Singles.	Doubles.	Led Horses.	Singles.	Doubles.	Led Horses.	Singles.	Doubles.	To Manhattan.	To Brooklyn.	
4.30 P.M..	42	14	..	78	27	..	120	41	3 50	6 60	10 10
5.00 " ..	49	14	..	70	24	1	119	38	3 85	5 93	9 78
5.30 " ..	28	13	..	95	46	..	123	59	2 70	9 35	12 05
6.00 " ..	32	13	..	100	50	2	132	63	2 90	10 06	12 96
6.30 " ..	42	12	1	78	51	2	120	63	3 33	9 06	12 39
7.00 " ..	15	9	1	69	24	2	84	33	1 68	5 91	7 59
7.30 " ..	13	8	12	32	22	3	45	30	1 81	3 89	5 70
8.00 " ..	8	7	9	21	10	..	29	17	1 37	2 05	3 42
8.30 " ..	5	13	3	5	4	2	10	17	1 64	71	2 35
9.00 " ..	1	4	2	11	5	..	12	9	51	1 05	1 56
9.30 " ..	10	9	..	4	3	..	14	12	1 40	50	1 90
10.00 " ..	3	9	..	7	12	..	10	21	1 05	1 55	2 60
10.30 " ..	..	4	6	3	3	..	3	7	58	45	1 03
11.00 " ..	4	2	..	4	3	..	8	5	40	50	90
11.30 " ..	3	3	..	2	5	2	5	8	45	66	1 11
12.00 " ..	3	3	..	6	7	2	9	10	45	1 06	1 15
Totals...	1,338	650	49	1,304	558	39	2,642	1,208	$133 37	$122 17	$255 54

Brooklyn Bridge.

Carraigeway Traffic by Half Hours for Monday, October 26, 1903.

Time.	To Manhattan.			To Brooklyn.			Total Vehicles.		Receipts		Total Receipts.
	Singles.	Doubles.	Led Horses.	Singles.	Doubles.	Led Horses.	Singles.	Doubles.	To Manhattan.	To Brooklyn.	
12.30 A. M..	4	1	..	4	5	4	8	6	$0 30	$0 82	$1 12
1.00 " ..	3	2	..	1	6	9	4	8	35	92	1 27
1.30 " ..	3	4	..	2	3	..	5	7	55	40	95
2.00 " ..	12	1	..	7	6	7	19	7	70	1 16	1 86
2.30 " ..	19	5	..	..	3	..	19	8	1 45	30	1 75
3.00 " ..	7	3	..	8	1	..	15	4	65	50	1 15
3.30 " ..	4	6	..	..	..	..	4	6	80	....	80
4.00 " ..	5	5	..	2	1	..	7	6	75	20	95
4.30 " ..	7	7	..	4	1	..	11	8	1 05	30	1 35
5.00 " ..	4	5	..	18	2	..	22	7	70	1 10	1 80
5.30 " ..	15	10	..	19	3	..	34	13	1 75	1 25	3 00
6.00 " ..	13	5	2	3	2	..	16	7	1 21	35	1 56
6.30 " ..	16	3	..	9	4	..	25	7	1 10	85	1 95
7.00 " ..	31	32	2	2	2	..	33	34	4 81	30	5 11
7.30 " ..	52	39	1	10	3	..	62	42	6 53	80	7 33
8.00 " ..	66	43	2	13	7	..	79	50	7 66	1 35	9 01
8.30 " ..	94	43	..	25	7	1	119	50	9 00	1 98	10 98
9.00 " ..	71	29	1	27	4	..	98	33	6 48	1 75	8 23
9.30 " ..	48	22	..	28	15	..	76	37	4 60	2 90	7 50
10.00 " ..	64	33	3	30	19	..	94	52	6 59	3 40	9 99
10.30 " ..	51	19	..	50	15	2	101	34	4 45	4 06	8 51
11.00 " ..	51	23	2	33	11	..	84	34	4 91	2 75	7 66
11.30 " ..	39	15	..	44	17	..	83	32	3 45	3 90	7 35
12.00 M....	42	13	..	35	15	..	77	28	3 40	3 25	6 65
12.30 P. M..	35	15	1	32	12	1	67	27	3 28	2 83	6 11
1.00 " ..	22	13	..	44	9	..	66	22	2 40	3 10	5 50
1.30 " ..	42	17	1	26	9	..	68	26	3 83	2 20	6 03
2.00 " ..	47	18	..	27	14	..	74	32	4 15	2 75	6 90
2.30 " ..	48	22	..	37	12	1	85	34	4 60	3 08	7 68
3.00 " ..	48	20	..	49	12	..	97	32	4 40	3 65	8 05
3.30 " ..	43	22	1	46	18	3	89	40	4 38	4 19	8 57
4.00 " ..	33	9	..	45	16	..	78	25	2 55	3 85	6 40

Time.	To Manhattan.			To Brooklyn.			Total Vehicles.		Receipts.		Total Receipts.
	Singles.	Doubles.	Led Horses.	Singles.	Doubles.	Led Horses.	Singles.	Doubles.	To Manhattan.	To Brooklyn.	
4.30 P. M..	48	21	1	69	29	..	117	50	$4 53	$6 35	$10 88
5.00 " ..	31	10	..	70	28	..	101	38	2 55	6 30	8 85
5.30 " ..	30	9	..	106	43	1	136	52	2 40	9 63	12 03
6.00 " ..	32	7	1	106	44	..	138	51	2 33	9 70	12 03
6.30 " ..	17	10	..	62	40	2	79	50	1 85	7 16	9 01
7.00 " ..	15	14	..	21	33	..	36	47	2 15	4 35	6 50
7.30 " ..	15	4	..	23	22	..	38	26	1 15	3 35	4 50
8.00 " ..	6	11	14	10	4	..	16	15	1 82	90	2 72
8.30 " ..	8	8	1	11	7	2	19	15	1 23	1 31	2 54
9.00 " ..	2	4	1	6	5	..	8	9	53	80	1 33
9.30 " ..	3	8	6	7	5	..	10	13	1 13	85	1 98
10.00 " ..	8	4	1	2	6	..	10	10	83	70	1 53
10.30 " ..	2	2	2	4	1	1	6	3	36	33	69
11.00 " "	1	3	..	2	1	..	3	4	35	20	55
11.30 " ..	2	3	..	4	5	..	6	8	40	70	1 10
12.00 " ..	3	..	..	1	5	..	4	5	15	55	70
Totals...	1,262	622	43	1,184	532	34	2,446	1,154	$126 59	$113 42	$240 01

Brooklyn Bridge.

Carriageway Traffic by Half Hours for Monday, October 17, 1904.

Time.	To Manhattan.			To Brooklyn.			Total Vehicles.		Receipts.		Total Receipts.
	Singles.	Doubles.	Led Horses.	Singles.	Doubles.	Led Horses.	Singles.	Doubles.	To Manhattan.	To Brooklyn.	
12.30 A. M. ..	7	1	..	2	3	2	9	4	$0 45	$0 46	$0 91
1.00 " ..	7	4	..	2	9	5	9	13	75	1 15	1 90
1.30 " ..	3	1	..	2	3	1	5	4	25	43	68
2.00 " ..	8	2	..	4	..	..	12	2	60	20	80
2.30 " ..	21	7	..	2	2	4	23	9	1 75	42	2 17
3.00 " ..	7	6	..	4	6	2	11	12	95	86	1 81
3.30 " ..	13	6	2	..	1	..	13	7	1 31	10	1 41
4.00 " ..	5	6	..	3	2	..	8	8	85	35	1 20
4.30 " ..	4	8	..	2	..	..	6	8	1 00	10	1 10
5.00 " ..	9	8	..	12	2	..	21	10	1 25	80	2 05
5.30 " ..	13	5	..	19	3	..	32	8	1 15	1 25	2 40
6.00 " ..	14	4	..	4	3	..	18	7	1 10	50	1 60
6.30 " ..	12	7	..	4	1	..	16	8	1 30	30	1 60
7.00 " ..	26	19	1	11	3	..	37	22	3 23	85	4 08
7.30 " ..	45	39	5	11	7	..	56	46	6 30	1 25	7 55
8.00 " ..	61	44	3	8	5	..	69	49	7 54	90	8 44
8.30 " ..	91	33	..	24	9	1	115	42	7 85	2 13	9 98
9.00 " ..	66	25	..	20	12	..	86	37	5 80	2 20	8 00
9.30 " ..	58	26	1	40	12	..	98	38	5 53	3 20	8 73
10.00 " ..	44	26	..	37	17	..	81	43	4 80	3 55	8 35
10.30 " ..	46	27	3	47	12	..	93	39	5 09	3 55	8 64
11.00 " ..	52	28	..	32	9	..	84	37	5 40	2 50	7 90
11.30 " ..	45	11	..	38	3	..	83	14	3 35	2 20	5 55
12 M. " ..	40	14	..	37	13	..	77	27	3 40	3 15	6 55
12.30 P. M. ..	28	15	..	44	14	..	72	29	2 90	3 60	6 50
1.00 " ..	31	15	..	38	20	1	69	35	3 05	3 93	6 98
1.30 " ..	29	20	2	33	9	..	62	29	3 51	2 55	6 06
2.00 " ..	38	14	..	34	7	1	72	21	3 30	2 43	5 73
2.30 " ..	53	22	..	40	14	3	93	36	4 85	3 49	8 34
3.00	59	20	..	42	16	..	101	36	4 95	3 70	8 65
3.30 " ..	34	18	..	47	18	..	81	36	3 50	4 15	7 65
4.00 " ..	21	12	..	34	10	..	55	22	2 25	2 70	4 95

Time.	To Manhattan.			To Brooklyn.			Total Vehicles.		Receipts.		Total Receipts.
	Singles.	Doubles.	Led Horses.	Singles.	Doubles.	Led Horses.	Singles.	Doubles.	To Manhattan.	To Brooklyn.	
4.30 P.M..	56	26	..	63	33	1	119	59	$5 40	$6 48	$11 88
5.00 " ..	39	8	..	64	28	..	103	36	2 75	6 00	8 75
5.30 " ..	34	10	1	115	56	6	149	66	2 73	11 53	14 26
6.00 " ..	33	22	2	81	44	3	114	66	3 91	8 54	12 45
6.30 " ..	25	9	..	53	30	1	78	39	2 15	5 68	7 83
7.00 " ..	18	12	..	42	26	4	60	38	2 10	4 82	6 92
7.30 " ..	7	6	..	16	16	1	23	22	95	2 43	3 38
8.00 " ..	9	7	2	8	4	..	17	11	1 21	80	2 01
8.30 " ..	11	11	1	7	3	..	18	14	1 68	65	2 33
9.00 " ..	8	13	7	5	2	2	13	15	1 91	51	2 42
9.30 " ..	2	8	..	2	4	..	4	12	90	50	1 40
10.00 " ..	1	9	..	10	10	..	11	19	95	1 50	2 45
10.30 " ..	5	6	2	2	6	..	7	12	91	70	1 61
11.00 " ..	5	4	..	2	2	..	7	6	65	30	95
11.30 " ..	5	1	..	1	3	..	6	4	35	35	70
12.00 " ..	2	..	..	3	8	2	5	8	10	1 01	1 11
Totals....	1,250	645	32	1,151	520	40	2,411	1,165	$127 96	$110 75	$238 71

Brooklyn Bridge.

Promenade Traffic by Half Hours for November 10, 1902.

Time.	To Manhattan.	To Brooklyn.	Total.	Time.	To Manhattan.	To Brooklyn.	Total.
12.30 A. M.	12	14	26	1.00 P. M.	148	270	418
1.00 "	10	10	20	1.30 "	136	190	326
1.30 "	5	5	10	2.00 "	147	175	322
2.00 "	5	4	9	2.30 "	138	180	318
2.30 "	2	19	21	3.00 "	132	196	328
3.00 "	1	9	10	3.30 "	136	184	320
3.30 "	3	23	26	4.00 "	163	293	456
4.00 "	9	9	18	4.30 "	136	288	424
4.30 "	4	11	15	5.00 "	112	330	442
5.00 "	9	12	21	5.30 "	164	677	841
5.30 "	10	14	24	6.00 "	162	891	1,053
6.00 "	28	48	76	6.30 "	157	635	792
6.30 "	81	39	120	7.00 "	149	282	431
7.00 "	176	57	233	7.30 "	206	195	401
7.30 "	310	63	373	8.00 "	196	122	318
8.00 "	352	80	432	8.30 "	252	114	366
8.30 "	517	102	619	9.00 "	174	142	316
9.00 "	527	143	670	9.30 "	130	105	235
9.30 "	379	131	510	10.00 "	105	84	189
10.00 "	328	187	515	10.30 "	54	46	100
10.30 "	264	183	447	11.00 "	32	33	65
11.00 "	271	206	477	11.30 "	21	29	50
11.30 "	231	192	423	12.00 "	7	20	27
12.00 M.	192	246	438				
12.30 P. M.	169	208	377	Totals	6,952	7,496	14,448

Brooklyn Bridge.

Time.	Promenade Traffic by Half Hours for Monday, October 26, 1903. To Manhattan.	To Brooklyn.	Total.	Passengers on Vehicles by Half Hours for Monday, October 26, 1903. To Manhattan.	To Brooklyn.	Total.	Grand Total.
12.30 A. M......	19	16	35	2	11	13	48
1.00 "	4	12	16	8	3	11	27
1.30 "	8	12	20	8	13	21	41
2.00 "	7	4	11	12	11	23	34
2.30 "	2	6	8	32	5	37	45
3.00 "	3	13	16	8	4	12	28
3.30 "	4	11	15	17	1	18	33
4.00 "	5	8	13	9	4	13	26
4.30 "	3	11	14	19	7	26	40
5.00 "	8	12	20	13	24	37	57
5.30 "	20	25	45	25	32	57	102
6.00 "	22	24	46	24	7	31	77
6.30 "	35	44	79	31	23	54	133
7.00 "	96	59	155	95	4	99	254
7.30 "	253	116	369	173	20	193	562
8.00 "	384	92	476	171	24	195	671
8.30 "	405	104	509	202	65	267	776
9.00 "	535	119	654	189	57	246	900
9.30 "	240	170	410	131	72	203	613
10.00 "	209	117	326	108	84	192	518
10.30 "	130	190	320	168	114	282	602
11.00 "	85	145	230	108	85	193	423
11.30 "	165	120	285	101	123	224	509
12.00 M........	120	124	244	90	115	205	449
12.30 P. M......	156	103	259	80	63	143	402
1.00 "	68	108	176	67	74	141	317

	Promenade Traffic by Half Hours for Monday, October 26, 1903.			Passengers on Vehicles by Half Hours for Monday, October 26, 1903.			
Time.	To Manhattan.	To Brooklyn.	Total.	To Manhattan.	To Brooklyn.	Total.	Grand Total.
1.30 P.M......	81	147	228	91	78	169	397
2.00 "	101	156	257	97	70	167	424
2.30 "	118	122	240	105	83	188	428
3.00 "	87	145	232	110	117	227	459
3.30 "	102	88	190	100	97	197	387
4.00 "	115	124	239	90	109	199	438
4.30 "	51	145	196	104	142	246	442
5.00 "	75	188	263	56	166	222	485
5.30 "	76	468	544	92	211	303	847
6.00 "	52	679	731	58	298	356	1,087
6.30 "	43	419	462	37	194	231	693
7.00 "	42	137	179	46	105	151	330
7.30 "	29	61	90	29	54	83	173
8.00 "	39	45	84	45	48	93	177
8.30 "	31	39	70	30	34	64	134
9.00 "	17	44	61	12	26	38	99
9.30 "	14	35	49	18	16	34	83
10.00 "	18	41	59	15	18	33	92
10.30 "	19	24	43	8	9	17	60
11.00 "	14	17	31	11	4	15	46
11.30 "	13	14	27	3	29	32	59
12.00 M........	11	8	19	2	23	25	44
Totals......	4,134	4,911	9,045	3,050	2,976	6,026	15,071

Brooklyn Bridge.

Time.	Promenade Traffic by Half Hours for Monday, October 17, 1904. To Manhattan.	To Brooklyn.	Total.	Passengers on Vehicles by Half Hours for Monday, October 17, 1904. To Manhattan.	To Brooklyn.	Total.	Grand Total.
12.30 A. M......	10	14	24	9	2	11	35
1.00 "	13	10	23	11	5	16	39
1.30 "	6	27	33	9	2	11	44
2.00 "	11	13	24	10	1	11	35
2.30 "	10	16	26	27	1	28	54
3.00 "	6	17	23	15	5	30	53
3.30 "	7	17	24	29	....	29	53
4.00 "	9	10	19	9	1	10	29
4.30 "	2	10	12	22	....	22	34
5.00 "	6	5	11	18	1	19	30
5.30 "	10	18	28	19	10	29	57
6.00 "	22	33	55	22	5	27	82
6.30 "	40	67	107	24	3	27	134
7.00 "	110	85	195	58	2	60	255
7.30 "	247	106	353	117	8	125	478
8.00 "	346	110	456	154	6	160	616
8.30 "	445	95	540	96	27	123	663
9.00 "	664	138	802	80	11	91	893
9.30 "	475	225	700	88	45	133	833
10.00 "	300	170	470	72	49	121	591
10.30 "	300	243	543	66	36	102	645
11.00 "	308	263	571	57	49	106	677
11.30 "	254	220	474	53	29	82	556
12.00 M........	240	235	475	47	36	83	558
12.30 P. M......	215	199	414	31	55	86	500
1.00 "	209	241	450	49	50	99	549

Time.	Promenade Traffic by Half Hours for Monday, October 17, 1904. To Manhattan.	To Brooklyn.	Total.	Passengers on Vehicles by Half Hours for Monday, October 17, 1904. To Manhattan.	To Brooklyn.	Total.	Grand Total.
1.30 P. M.	212	245	457	41	55	96	553
2.00 "	235	202	437	27	43	70	507
2.30 "	169	210	379	66	50	116	495
3.00 "	212	160	372	49	29	78	450
3.30 "	215	234	449	47	53	100	549
4.00 "	202	299	501	39	27	66	567
4.30 "	174	130	304	51	62	116	420
5.00 "	398	146	544	44	86	130	674
5.30 "	708	162	870	50	119	169	1,039
6.00 "	909	98	1,007	48	180	228	1,235
6.30 "	637	147	784	24	131	155	939
7.00 "	153	109	262	18	110	128	390
7.30 "	144	100	244	13	49	62	306
8.00 "	92	84	176	11	18	29	205
8.30 "	105	77	182	10	11	21	203
9.00 "	78	56	134	16	6	22	156
9.30 "	79	82	161	8	12	20	181
10.00 "	57	44	101	6	21	27	128
10.30 "	54	39	93	6	11	17	110
11.00 "	51	17	68	5	7	12	80
11.30 "	29	32	61	1	3	4	65
12.00 "	29	18	47	1	16	17	64
Totals	7,207	5,278	14,485	1,773	1,541	3,314	17,799

Cables and Wires for Telegraph, Telephone and Electric Power.

In September, 1904, the Commercial Cable Company laid three new four-conductor steel-armored telegraph cables across the Bridge, and in November, 1904, the Police Department laid a fourteen-wire telephone cable.

Following is a list of cables and wires in service on the Bridge for which rental is charged:

Gold Stock and Telegraph Co.	1 cable,	26 wires
Postal Telegraph Co.	1 "	10 "
Western Union Telegraph Co.	1 "	55 "
Thomas F. White		1 "
Brooklyn Heights Railroad Co.	1 "	6 "
" " " " (in 20-wire cable)		4 "
Commercial Cable Co., 7 steel-armored Atlantic cables		28 "
Total		130 wires

Western Union Telegraph Co.	1 steel-armored Atlantic cable
New York Edison Co.	2 cables (lead covered), electric power

The following wires are free from rental charges:

Brooklyn Bridge, 1 cable of 20 wires, used as follows:

Bridge service	6 wires	
" police	2 "	
Bridge railway (Brooklyn Heights Railroad Co.)	8 "	
City of New York—Fire and Police service	4 "	
" " " " " " "	14 "	(1 cable)

Rent Roll—Telegraph, Telephone and Electric Power Wires.

Western Union Telegraph Co.	$1,650 00
Gold Stock and Telegraph Co.	720 00
Thomas F. White	30 00
Postal Telegraph Co.	300 00
Commercial Cable Co.	970 00
Brooklyn Elevated Railroad Co.	60 00
Brooklyn Heights Railroad Co.	180 00
Western Union Telegraph Co.	250 00
The New York Edison Co.	2,000 00
The Holmes Electric Protective Co.	5 00
	$6,165 00

Bridge Property.

The workshops, stations, elevated and surface railway connections and appurtenances, and the warehouses and other property under and adjoining the bridge, under the care of the Department of Bridges, have been maintained in good condition and repair.

The rent roll, December, 1904, was as follows:

Premises.	Tenants.	Occupation.	Rent.
Warehouse 1	F. McSwegan	Machinery	$2,000 00
Warehouse 2	Uncas Paper Company	Storage	1,500 00
Warehouses 3 and 4	Brooklyn Bridge Freezing and Cold Storage Company	"	4,500 00
Warehouse 5	Brooklyn Bridge Freezing and Cold Storage Company	"	2,250 00
Warehouse 6	Brooklyn Bridge Freezing and Cold Storage Company	"	2,250 00
Warehouses 7, 8, 9, 10, 11	Brooklyn Bridge Stores Company	"	5,000 00
Warehouse 12	The Star Company	Printing	1,800 00
Warehouse 13	"	"	1,800 00
Warehouse 14	"	"	1,800 00
Warehouse 15	Meyer Hecht	Leather	1,500 00
Warehouse 16	Street & Smith	Printing	1,500 00
Warehouse 17	Hirsch & Kaiser	Leather	1,500 00
Blocks "E" and "G" and north vaults	Luyties Brothers	Wines	4,000 00
Block "F"	John Racky	"	275 00
348–352 Pearl street	C. G. Smith	Lamps	3,000 00
262–274 Front street	Baker & Williams	Storage	5,700 00
285–297 Water street	"	"	
Front street gore	James F. Cosgrove	"	15 00
280 Front street	M. O'Connor & Sons	Stable	650 00
273–275 Front street	John O'Meara	"	1,000 00
279 Front street	J. & B. Cosgrove's Sons	Cooperage	720 00
281 Front street	"	"	600 00
166 South street	William Man	Iron	600 00
167 South street	M. Paltrowitz	Junk	700 00

Premises.	Tenants.	Occupation.	Rent.
168 South street	Israel Etkin	Store	700 00
169 South street	Estate of John Harrison	Junk	650 00
170 South street	"	"	800 00
171–172 South street	Egleston Brothers & Co.	Iron	800 00
Pier 29, East river	Wm. P. Clyde & Co.	Dock	6,500 00
Water street arches	New York Telephone Company	Storage	2,000 00
South vaults	"The World"	"	2,000 00
South vaults cellar	"	"	180 00

BROOKLYN.

Premises.	Tenants.	Occupation.	Rent.
Tower wharf	John H. Starin	Dock	$2,750 00
Tower yard	Brooklyn Elevated Railroad Company	Station	5,000 00
21–23 Water street	Marston & Son	Coal yard	4,250 00
14–16 Water street	W. E. Jones		600 00
14–16 Water street (rear first floor)	Vacant		
14–16 Water street (rear basement)	Phillips, Doupe & Co.	Storage	100 00
18 Water street (two floors)	L. Nachmann	Novelties	100 00
18 Water street (cellar)	Commercial Cable Company	Storage	144 00
Prospect street arches	H. R. Healy	"	400 00
Plaza	Kings County Elevated Railroad Company		400 00
Southeast corner of Dock and Water streets	Philip Lewinsky	Junk	225 00
Warehouses "C" and "D," York street	Brooklyn Heights Railroad Company	Storage battery	400 00
Washington street	Brooklyn City and Newtown Railroad Company	Siding	500 00
"	Nassau Electric Railroad Company	"	1,000 00
	New York Mail and Newspaper Transportation Company	Mail tube	1,000 00
	Brooklyn Elevated Railroad Company	Tracks, cars, stations and power plant of bridge railway	20,306 28
		Total	$95,465 28

New York and Brooklyn Bridge.

Statement of Receipts and Expenditures for the Year 1904.

RECEIPTS.

Tolls—		
Roadways	$73,809 33	
Elevated railroad cars	89,250 00	
Trolley cars	66,663 90	
		$228,723 23
Rents—		
Real estate	$94,978 82	
Wires	6,139 13	
Mail tubes	1,000 00	
		102,117 95
Material sold at auction		2,807 00
Correction of error—Voucher returned by Comptroller		106 17
		$334,754 35
For labor and materials furnished to—		
Borough of Brooklyn bridges	$6,793 93	
Borough of Richmond bridges	178 81	
Borough of Queens bridges	526 06	
Borough of The Bronx bridges	36 08	
Harlem river bridges	7,063 27	
Newtown creek bridges	7,435 09	
Williamsburg Bridge (No. 2)	63,832 42	
		85,865 66
For labor and materials furnished to—		
Brooklyn Rapid Transit Co.	$2,089 20	
Electric Carriage Co.	31 50	
		2,120 70
		$422,740 71

EXPENDITURES.

Salaries—Engineers, office staff, foremen, etc.	$57,133 16	
Pay-rolls—		
Regular	239,800 04	
Emergency	5,265 25	
Materials and supplies, certified to Comptroller	81,987 03	
		$384,185 48
Balance on hand December 31, 1904		38,555 23
		$422,740 71

Included in the total expenditures is the cost of labor and materials furnished by the New York and Brooklyn Bridge for

work on other bridges in the Department, and for tenants of the Bridge, as follows:

Borough of Brooklyn bridges	$8,714 78	
Borough of Queens bridges	1,723 77	
Borough of The Bronx bridges	82 60	
Borough of Richmond bridges	68 40	
Harlem river bridges	2,969 66	
Newtown creek bridges	10,251 99	
Williamsburgh Bridge (No. 2)	46,787 99	
Manhattan Bridge (No. 3)	2,775 31	
Blackwell's Island Bridge (No. 4)	1,617 07	
		$74,991 57
Brooklyn Rapid Transit Co.	$969 58	
Commercial Cable Co.	790 79	
		1,760 37
		$76,751 94

Respectfully submitted,

ARCHIBALD McLEAN,
Engineer in Charge, Brooklyn Bridge.

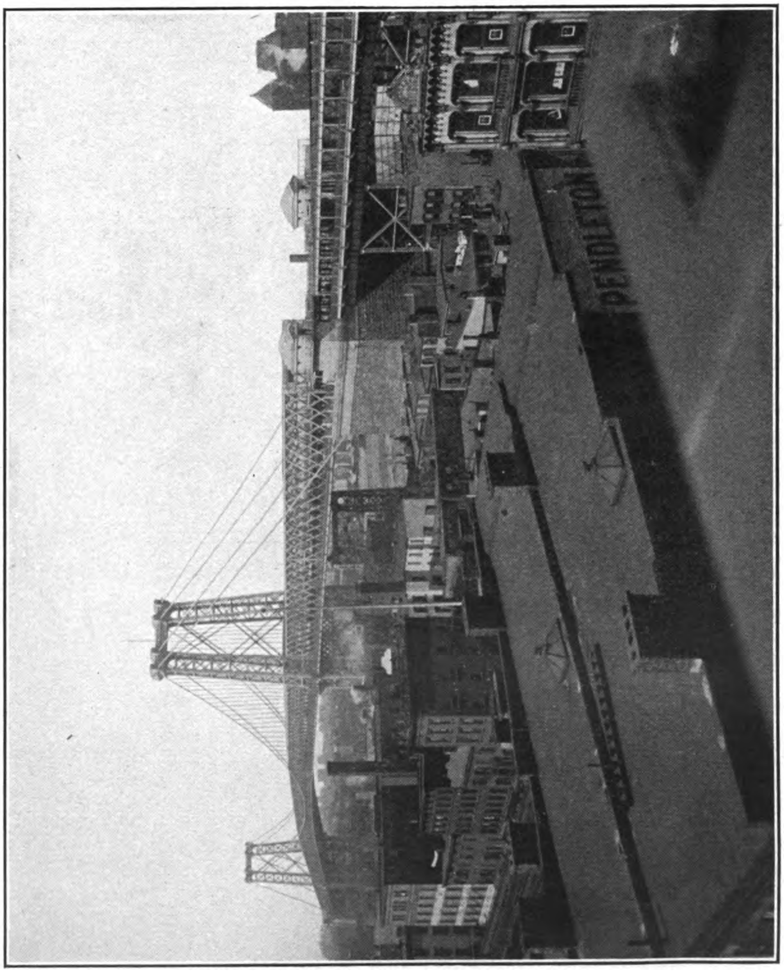
Williamsburgh Bridge.

O. F. Nichols, Esq.,
Chief Engineer, Department of Bridges:

Dear Sir—On December 31, 1901, there were completed or under way nine principal contracts. The Manhattan and Brooklyn tower foundation contracts were completed, the Manhattan and Brooklyn towers and end spans and anchorages were completed as far as possible until the stringing of cables was finished. The stringing of the cables had commenced on November 27, 1901, but only two strands of the 148 had been completed and regulated in place, and two others were practically completed.

Of the steel and masonry approach contract on the Brooklyn side about one-half the steel work had been erected, about three-quarters of the work completed at the shop and about one-half the masonry approach was completed.

On the steel and masonry approach on the Manhattan side the buildings had been removed from the site for the entire length of the approach, and all the pile foundations required had been practically completed on two blocks west of the anchorage. The excavation for the terminal masonry and for the column foundations in the two blocks adjoining such masonry were well under way. Nearly all the steel for this approach had been



EAST RIVER BRIDGE NO. II—WILLIAMSBURGH BRIDGE.

manufactured, but very little shop work done, and none had been delivered at the site.

On the steel suspended span, the contract for which had been let to the Pennsylvania Steel Company, in May, 1901, no work had been done except the preparation of the shop drawings, many of which had been completed and approved.

The progress of stringing the cables had been very slow, principally on account of the inexperience of the men in doing that work, and because of the inefficiency of portions of the cable-stringing plant.

The chief defects in the cable-stringing machinery consisted of weaknesses in the traveling sheaves and frames, in the supporting sheaves of the traveling ropes on tops of the main towers and from the fact that the whole cable-making machinery was operated by one engine and line of shafting on the New York anchorage.

As rapidly as the defects were observed and plans were agreed upon between the Bridge Department engineers and the contractor's engineer for bettering these conditions improvements were made and the progress in stringing cables became more rapid.

On account of the loop of running rope along the two southerly cables and the loop of running rope along the two northerly cables being operated by one line of shafting and engine, whenever an accident occurred to the traveling sheave on any one rope or it was necessary to slow down the speed of one loop or running rope, there was suspension or delay of all wire stringing until the defects were remedied.

In April, a duplicate of the driving engine already in place was installed and the shafting cut so that two loops of running rope used in hauling the traveling sheaves for stringing cable strands were operated independently, and with the improved traveling sheaves and frames and traveling rope supporting sheaves on tops of the towers the efficiency of the plant was very much increased.

The stringing and regulating of the 148 strands of all four cables were completed on June 27, 1902, and the work of removing the strand seizings still in place on the outside strands and squeezing the cables into cylindrical form began immediately thereafter.

There was a considerable delay during the summer of 1902

on account of the slow delivery of the cast-steel cable bands and other parts of the permanent work from the foundry.

In September, after numerous experiments had been tried to determine a method of permanently protecting the wires of cables from the weather, it was decided to wrap the cables with three-ply cotton duck which had been treated with a compound prepared by Edward Smith & Co., varnish makers, of Long Island City, and a supplemental agreement was entered into with the John A. Roebling's Sons Company, on September 30, 1902, to do this work of waterproofing the cables and placing two 1⅜-inch hand-rail ropes along and over each cable, in connection with its contract for cable making, etc.

The canvas, which had been filled with the hot liquified cable compound, was brought to the site of the work in strips seven inches wide and applied to the cables by wrapping continuously around each cable and lapping the layers two-thirds, so that when any portion of this work was completed the cable was covered with three thicknesses of canvas. After the wrapping was completed and it was gone over with hot irons and the layers thoroughly cemented together, the surface was then given two coats of Edward Smith & Co.'s durable metal coating, which consisted of about the same ingredients as the compound used in filling the canvas. The sheet-metal covers were then applied on the cables from cable band to cable band as a final protection to the cables.

This work had progressed satisfactorily, although somewhat retarded by the slowness of delivery of cable bands, and was nearing completion when, on November 10, 1902, a fire occurred on top of the Manhattan tower which destroyed the framework used in stringing the cables and heated the wire-rope cables supporting the foot bridges, where they rested on the tower, to such an extent that they parted, wrecking the foot bridges. The outer wires of the two southerly cables were also damaged to an extent of about 2 per cent. on the south outer cable and about 6 per cent. on the south inner cable.

New working platforms were required to complete the work on the cables, and were constructed along and supported by the main cables, and the wrecked foot bridges, the greater portion of which in the main span hung in the bights of the suspenders already in place, were removed, so that the work of erecting the suspended span was begun without much delay.

The Commissioner of Bridges appointed Messrs. L. L. Buck,

George S. Morrison and C. C. Schneider to investigate the damage done to the main cables on top of the Manhattan tower. After a thorough investigation and tests made in conjunction with the bridge engineers this Commission reported a method of repairing the cables (Appendix B). It was found that the south outer cable was damaged only on its upper side, the damage extending over the length of the saddle, and the number of affected wires was found to be about 175. In the south inner cable the damage extended on the top side of the cable over the saddle and around the under side of the cable east of saddle. On the top of the saddle it was found that about 160 wires were damaged, and around the cable at the end about 300 wires.

As recommended by the Commission, the damaged wires on tops of both cables were cut out and new ones spliced in and connected by the regular sleeve-nut splices used throughout the cables. As it was impossible to renew the damaged wires under the south inner cable east of saddle, the Commission directed that the loose wires be cut shorter, and spliced, giving them the proper tension, and that a sufficient number of reinforcing wires be applied and fastened to the cables by friction clamps and bands at points east and west of the saddles and extending over the saddles, and also that an additional number of wires be fastened in the same manner, to make up for the loss of strength due to field splicing of the wires over saddles on both cables.

In accordance with the recommendation of the Commission, 20 reinforcing wires were attached to the south outer cable and 180 reinforcing wires to the south inner cable by means of the friction clamps, and also wrapped with wire to increase the frictional resistance. It is probable that the cables at this point now are as strong as before, and are 8 to 10 per cent. stronger than the specifications required.

The wrecked foot bridges were removed and working platforms constructed along all four cables from end to end and completed the last week in December, and the contractor for the suspended structure had already begun the erection of portions of that span at the towers, and early in January the erection of the suspended span proper was begun and continued without interruption.

The erection of the suspended span, after the work was thoroughly under way, proceeded without serious accident or interruption, except for short delays in delivery of some of the material and on account of large amount of reaming bottom chord

splices, rendered necessary by misfit of splice plates. The completion of the erection of the Brooklyn approach and the construction of the Manhattan steel and masonry approach were conducted in such manner that the final completion of the three contracts by the Pennsylvania Steel Company was practically at the same time, about December 1, 1903.

The Commission appointed to report on the damage to cables by the fire also reported in favor of the construction of fireproof floors for the carriageways, footwalks, tracks, etc. (Appendix C).

Plans and specifications were prepared in accordance with its recommendation for the construction of fireproof floors for the carraigeways of the main and end spans, and two contracts, one for the steel under flooring and the other for creo-resinate wood block paving to be laid thereon, were let to the R. H. Hood Company and the United States Wood Preserving Company, respectively.

The work on the steel under flooring was commenced as soon as the shop plans were prepared and approved, and has been carried quite rapidly and successfully to completion. As soon as possible the United States Wood Preserving Company began laying the wood block paving, and the south roadway pavement, from anchorage to anchorage, was completed on December 19, 1903, in time for the public opening of the bridge.

Plans and specifications for paving the carriageways over the approaches and anchorages, providing for a pavement consisting of Medina sandstone blocks laid on concrete foundations, with mortar joining, were prepared, and in August the work was awarded to the United Engineering and Contracting Company. Work was begun immediately thereafter, and was hurried forward, but a great deal of delay was caused by the Medina blocks at first delivered not meeting the specification requirements, by the failure of the quarry company to deliver the blocks as rapidly as required because of trouble in obtaining cutters enough, and finally by the last shipments of several barge loads being frozen fast in the Erie Canal. The south carriageway was completely paved for the entire length of each approach and anchorage by December 18, 1903.

After considerable investigation and tests a plan for fireproof foot-walk floors was adopted, and plans and specifications for the construction of the same were prepared. This floor consists of a corrugated enameled sheet steel under floor laid on the longitudinal stringers of the foot walks and supporting an asphalt

mastic wearing surface laid on concrete foundation. The contract for this work was let to the R. H. Hood Company the latter part of October, 1903.

Plans and specifications were prepared for improving the property under the Manhattan steel viaduct approach by constructing cement "Kosmocrete" sidewalks and curbs around the blocks, constructing an asphalted roadway along the southerly clearance line of the bridge and asphalting the area within three of the blocks for the use of pushcart peddlers.

The area under the Brooklyn approach from Kent avenue to the beginning of the masonry approach at Bedford avenue was placed at the disposal of the Brooklyn Department of Parks, and has been laid out with cement walks and graded and otherwise improved as a park.

Plans and specifications were prepared for concreting in the anchor-chain tunnels of each anchorage, building masonry in the cable openings, at front of anchorages, building cross-bridges over well-holes and stairways and ladders to the interior of the anchorages. The contract for doing this work was awarded to John J. Hopper, of New York, about the middle of September, 1903.

The two whole blocks and parts of blocks for the Brooklyn Plaza of the bridge were condemned, the buildings razed and the area graded and temporarily paved according to specifications and plans prepared therefor, the contract having been awarded to the Cunningham & Kearns Contracting Company, of New York, in November, 1903.

Plans and specifications for the construction of comfort stations and tool houses and ornamental work on the anchorages, and ornamental work and electroliers at the roadway level of the main towers, and for the bronze name plates were prepared, and the contract for doing this work was awarded to the Snare & Triest Company, on November 12, 1903.

Plans and specifications for the installation of the electric wiring and fixtures for lighting the bridge were prepared, and the contract awarded to the Commercial Construction Company, on December 15, 1903.

Plans and specifications were prepared for the construction of housings or hoods over the cables and saddles on the tops of the main towers, and the contract for doing the work was awarded to the R. H. Hood Company, on December 29, 1903.

The repair of damage done to the Manhattan tower and end span due to the fire occurring on top of the tower was done by

the Pennsylvania Steel Company, under a supplemental agreement to their contract for the steel suspended span.

On December 19, 1903, the formal ceremonies of opening the bridge took place, and on December 21 the south roadway was opened to vehicles passing both ways.

The following table shows the dates of beginning and of completion of the several contracts on this bridge:

WILLIAMSBURGH BRIDGE CONTRACTS.

Contract.	Date of Contract.	Work Completed.
Manhattan tower foundation	Oct. 28, 1896	Sept., 1898
Brooklyn tower foundation	June 30, 1897	Mar., 1899
Brooklyn anchorage	Oct. 1, "	Oct., 1903
Manhattan anchorage	" 5, "	Sept. 10, "
Main towers and land spans	Feb. 21, 1899	Feb., 1901
Cables, suspenders, etc	Dec. 9, "	Aug., 1903
Brooklyn approach	Nov. 7, 1900	Oct., "
Manhattan approach	" 9, "	Dec. 10, "
Suspended superstructure	May 8, 1901	" 7, "
Steel under flooring	June 8, 1903	" 17, "
Wood block pavement	" 8, "	Jan. 17, 1904
Kosmocrete sidewalks, etc	July 22, "	May 26, "
Roadway paving	Aug. 14, "	" 17, "
Concreting anchor chain tunnels	Sept. 11, "	Apr. 22, "
Footwalk flooring, etc	Oct. 20, "	May 13, "
Comfort stations, name plates, etc	Nov. 12, "	Dec., "
Grading, paving, etc., Brooklyn Plaza	" 17, "	" 9, "
Electric wiring, etc	Dec. 15, "	Jan. 15, "
Hoods over saddles	" 29, "	Aug. 20, "
Asphalting under Manhattan approach	Jan. 12, 1904	May 28, "
Elevated railway and trolley tracks	Apr. 12, "	Dec. 6, "
Brooklyn Plaza, overhead trolley railway work	Aug. 5, "	" 1, "
Electric conduit tracks	Aug. 10, "	Work suspended on account of weather.

The Brooklyn Rapid Transit Company wished to run its elevated trains and its trolley cars over the bridge, and it was decided to have them use the space on the southerly side of the structure for the trolley surface tracks. Plans and specifications were prepared for the construction of the elevated railway and the overhead trolley tracks, and bids were asked for this work and opened April 8, 1904, with the following result:

Engineer's estimate	$130,000 00
Naughton Company	128,425 00
Holbrook, Cabot & Rollins	135,000 00
United Engineering and Contracting Company	137,450 00
James McFerran	138,000 00
T. E. & Thomas Crimmins	170,000 00
R. H. Hood Company	184,365 00

This contract was awarded to Naughton Company, the lowest bidders, under date of April 12, 1904.

The overhead railway tracks, loops, etc., on the Brooklyn Plaza were made the subject of a special contract on which bids were opened on July 26, 1904, with the following results:

Engineer's estimate	$105,000 00
Naughton Company	108,000 00
Frederick Holbrook	115,000 00
Seaboard Construction Company	155,000 00

The contract was awarded to Naughton Company, the lowest bidders, under date of August 10, 1904.

A traffic agreement was executed on May 21, 1904, by the Commissioner of Bridges with the Brooklyn Heights Railroad Company, the Coney Island and Brooklyn Railroad Company, the New York City Railway Company and the Bridge Operating Company, the last-named company being formed by the three other companies. This agreement provided for the operation of the four surface railway tracks of the bridge, the Brooklyn companies to operate their (overhead trolley) cars over the south pair of tracks and the New York company to operate its (underground trolley) cars on the north pair of tracks, all in extension of existing lines extended over the bridge and without additional fare, while the Bridge Operating Company was to operate local cars only over either the north or south pair of tracks, over the bridge and back, and charge three cents for a single fare and sell tickets at the rate of two fares for five cents.

The companies maintain the tracks and fittings, furnish the power and pay to the City five cents for each round trip over the bridge, and are to pay an upset rental of $10,000 per annum as soon as the tracks and the terminal station are fully completed. The inability of the Department to secure the ground on which to erect the terminal station shown on the plans required the construction of a temporary stub-end terminal of most limited capacity, which was to be built, paid for and operated by the operating company.

The plans and specifications for the electric conduit (New York City Railway) tracks involved a great deal of study and time in execution, requiring as they did material additions to the structure. Bids were opened for these tracks, including four large loops on the Brooklyn Plaza, on July 26, 1904, with the following results:

Engineer's estimate	$258,000 00
Snare & Triest Company	249,560 00
United Engineering and Contracting Company	321,745 00
Naughton Company	333,000 00
Seaboard Construction Company	357,000 00
Frederick Holbrook	360,000 00

The contract was awarded to the Snare & Triest Company, the lowest bidders, on August 10, 1904.

The cars of the Brooklyn Heights Railroad Company, the Coney Island and Brooklyn Railroad Company and the local bridge cars began running over the south pair of tracks on November 3, 1904. Seven lines of cars are run over the bridge in addition to the bridge local cars as follows:

Franklin Avenue Line, Broadway Line,
Nostrand Avenue Line, Bushwick Avenue Line,
Reid Avenue Line, Hamburg Avenue Line,
Grand Street Line.

There are four car stands at the Manhattan temporary terminal from which these cars start. The Franklin Avenue Line is entitled, under the traffic agreement, to run 16 per cent. of the cars operated over the south pair of tracks. The number of cars run over the bridge on two days, one soon after the cars first ran and the other near the close of the present year, is given in the tables herewith, as well as the total number of cars run for the

months of November and December, 1904, and the total number to date.

The greatest number of cars run over the bridge in one day was 1,354, on Saturday, December 31, and the greatest number of cars run over the bridge in one hour was 117, between 6 and 7 o'clock, on Thursday, December 29, 1904.

No actual count of passengers per day in the cars has yet been taken, but the number is probably in excess of 25,000.

Month.	Number of Cars run over the Bridge.
November, 1904	30,352
December, 1904	37,760
Total	68,112

Trips Operated Across Williamsburgh Bridge (South Roadway) Wednesday, November 9, 1904.

Time.	Brooklyn Heights R. R. Co.							C. I. & B. R. R. Co.	Bridge Locals.	Grand Total.
	Broadway.	Nostrand Ave.	Reid Ave.	Bushwick Ave.	Hamburg Ave.	Grand St.	Total.			
1 A. M.	4	4	3	3	5	2	21	8	8	37
2 "	3	3	2	..	..	..	8	5	9	22
3 "	..	3	3	..	..	..	6	5	9	20
4 "	..	1	2	..	..	..	3	1	8	12
5 "	..	2	2	..	..	..	4	2	7	13
6 "	1	2	1	1	1	1	7	1	8	16
7 "	4	3	2	5	5	3	22	3	18	43
8 "	8	6	4	6	5	4	33	6	27	66
9 "	7	7	4	5	6	4	33	7	21	61
10 "	7	5	4	4	4	2	26	6	12	44
11 "	6	6	4	4	6	4	30	8	13	51
12 M.	5	5	4	4	5	4	27	7	12	46
1 P. M.	5	4	4	4	4	4	25	7	12	44
2 "	8	4	4	4	6	3	29	6	12	47
3 "	7	8	4	5	5	3	32	8	11	51
4 "	7	6	4	5	4	4	30	5	11	46
5 "	9	7	5	6	7	5	39	9	18	66
6 "	15	7	5	7	12	6	52	9	22	83
7 "	15	9	6	9	14	6	59	7	22	88
8 "	3	6	3	5	4	3	24	5	18	47
9 "	9	7	5	5	6	4	36	7	12	55
10 "	5	4	2	2	5	3	21	7	7	35
11 "	5	5	3	4	3	1	21	6	7	34
12 "	4	4	3	3	5	2	21	6	8	35
Total. ..	137	118	83	91	112	68	609	141	312	1,062

Trips Operated Across Williamsburgh Bridge (South Roadway) Wednesday, December 28, 1904.

Time.	Brooklyn Heights R. R. Co.							C. I. & B. R. R. Co.	Bridge Locals.	Grand Total.
	Broadway.	Nostrand Ave.	Reid Ave.	Bushwick Ave.	Hamburg Ave.	Grand St.	Total.			
1 A. M.	2	4	..	1	2	2	11	4	6	21
2 "	3	3	..	..	..	..	6	4	4	14
3 "	3	2	..	..	..	..	5	2	4	11
4 "	2	2	..	..	..	..	4	2	4	10
5 "	2	2	..	..	..	..	4	4	4	12
6 "	2	3	..	3	1	1	10	2	7	19
7 "	4	4	..	6	6	7	27	1	24	52
8 "	17	9	9	10	12	9	66	7	43	116
9 "	8	8	6	7	7	5	41	8	30	79
10 "	10	8	5	3	7	4	37	7	18	62
11 "	7	5	4	4	5	3	28	6	15	49
12 M.	7	6	5	4	8	4	34	6	15	55
1 P. M.	9	6	4	4	6	4	33	6	15	54
2 "	11	6	4	4	6	3	34	6	15	55
3 "	16	9	4	2	7	4	42	7	13	62
4 "	11	7	4	5	6	4	37	6	24	67
5 "	10	7	6	5	11	5	44	7	29	80
6 "	18	11	7	10	12	11	69	6	33	108
7 "	22	10	7	9	11	8	67	8	31	106
8 "	10	6	4	8	11	3	42	6	17	65
9 "	9	5	3	2	7	3	29	7	13	49
10 "	8	8	4	4	4	3	31	5	10	46
11 "	7	6	2	2	3	3	23	5	7	35
12 "	2	5	3	2	3	2	17	2	9	28
Total......	200	142	81	95	135	88	741	124	390	1,255

Traffic Over the Roadways and Footwalks.

The roadways at once came into competition with the ferries, on account of their convenience and the certainty of passage over them, and on account of the saving effected by the reduced toll, which was made the same as for the Brooklyn Bridge, although this bridge is the longer by about 1,200 feet.

The traffic over the roadways for the month of December, 1904, was as follows:

From.	Led Horses at 3 Cents.	Single Vehicles at 5 Cents.	Double Vehicles at 10 Cents.	Receipts.
Manhattan	13,426	215,719	144,951	$25,683 83
Brooklyn	17,224	224,473	154,241	27,164 47
Total	30,650	440,192	299,192	$52,848 30

Total number of vehicles for 1904	739,384
Average per day, Sundays included	2,026
Total number of horses for 1904	1,069,226
Average per day, including Sundays	2,957

The receipts of toll on the roadways of the Brooklyn Bridge decreased 5 per cent. in 1904 over those of 1903, which is no doubt due in great measure to the opening of the Williamsburgh Bridge.

No count has yet been taken of the passengers on the footwalk, but there were many Sundays during last summer when there were upward of 7,000 persons on the bridge at one time, all generally in motion, a continuous procession of this dimension.

New Construction.

The immense crowds, especially of children, which flock onto the footwalks during the summer months, make it desirable to replace the pipe railings on these walls with lattice railing, and a contract will soon be let for this work, which should be completed before next summer.

Additional guards and footwalks must also be provided for the surface tracks.

Plans are being prepared for an electric light plant on the Manhattan side from which the bridge can be lighted. The

property between Kent avenue and the river, on the Brooklyn side, will also be utilized for the construction of a power house and shops on the line of Kent avenue, and the ground in front of this and along the bulkhead will be graded and fitted for the receipt of supplies by water or for the casual landing of vessels.

In time some form of shelter must be provided for the crowds who must change cars on the Brooklyn Plaza, and the structure provided for this purpose should possess æsthetic elements commensurate with its location and importance.

Old Pier No. 38, on the Manhattan side, is out of repair and cannot be retained for convenient use or without being a menace to the steel towers in case of fire, and must be removed. The water about the tower foundations and up to the bulkhead should be dredged to a safe and convenient depth, so that the bulkhead may be used for landing purposes if desired.

Land Under the Manhattan Approach.

The greater portion of the land between East and Tompkins streets will be given over to the use of the Street Cleaning Department, for the construction of a rubbish incinerator, and to the construction of an electric light plant for the bridge.

The land under the bridge on the blocks between the anchorage and Goerck street and between Lewis and Cannon streets has been assigned to the Board of Education for temporary school and playground purposes. The same space on the blocks between Goerck and Lewis streets has been assigned to the Park Department for playground purposes.

The same place on the blocks between Cannon and Sheriff and between Willett and Ridge streets has been assigned to the Street Cleaning Department for market and similar purposes.

The same space on the block between Sheriff and Willett streets has been assigned, the easterly portion to the Borough President for the construction of a comfort station and the westerly portion to the Fire Department for the construction of an engine house.

In addition to these assignments the Board of Education has been allowed to construct six one-story brick buildings for temporary school purposes on the strip of land along the southerly side of the bridge.

Maintenance.

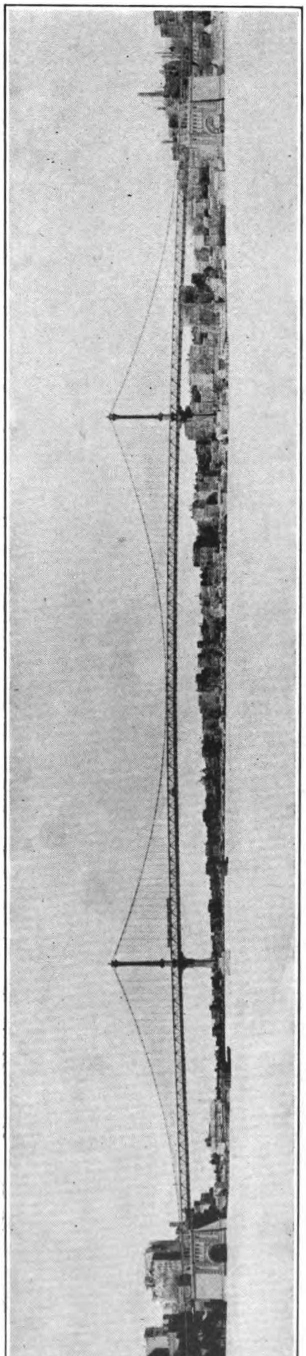
The area of the bridge footwalks, roadways, etc., and of the sidewalks, etc., about the bridge is at least 50 per cent. greater than on the Brooklyn Bridge, requiring a large force of men to keep this area clean and in order. This work has been done with the regular force assigned to the bridge and by special force employed for the removal of snow. The maintenance repairs have not been great, although there is always something to be done on a structure of this size and importance.

Disbursements for Construction to December 31, 1904.

Franchise, New East River Bridge Company	$205,488 88
Real Property	8,776,107 81
Legal expenses, incurred prior to January 1, 1902	50,833 62
Salaries, supplies and engineering expenses	654,125 33
Contracts for construction	9,948,423 70
Total	$19,634,979 34

Respectfully submitted,

KINGSLEY L. MARTIN,
Engineer in Charge, Williamsburgh Bridge.



EAST RIVER BRIDGE No. III.—MANHATTAN BRIDGE.

MANHATTAN BRIDGE.

DECEMBER 31, 1904.

O. F. NICHOLS, Esq.,
Chief Engineer, Department Bridges:

DEAR SIR—At the end of the year 1901 the controlling features of the design had been definitely fixed, the general plans had been developed and were in course of final preparation, the preliminary calculations for the towers, cables and superstructure had been practically completed, and the contract plans for the tower foundations and anchorages prepared.

The then Commissioner of Bridges decided early in the year 1902 to change the entire character of the bridge, substituting eye-bar chains for wire cables, spandrel bracing for the suspended stiffening truss and towers hinged at the base for towers fixed at the base. The capacity of the bridge was also increased by adding two elevated tracks.

The proposed changes were passed on by a special commission of engineers appointed by the Mayor February 10, 1903, composed of Messrs. George S. Morison, Mansfield Merriman, C. C. Schneider, Henry W. Hodge and Theodore Cooper.

This commission made a preliminary report March 9, 1903, and a final report June 29, 1903, approving the proposed design.

The plans were approved by the Art Commission March 10, 1903. The Board of Estimate and Apportionment passed a resolution appropriating $6,532,000 for the construction of the anchorages and steel superstructure of the bridge.

A resolution in the Board of Aldermen authorizing a bond issue for this amount was defeated by that body July 14, 1903.

Again, on July 15, 1903, the Board of Estimate passed a resolution authorizing a bond issue of $6,532,000, which resolution was defeated in the Board of Aldermen July 31, 1903.

Contract plans and specifications for the anchorages and superstructure were prepared, but, for lack of funds, these contracts were not awarded.

Early in 1904 it was decided by the Commissioner of Bridges to reject the eye-bar chain design for this bridge, and to return to the wire cable type originally proposed and authorized. The arrangement of spans, capacity and loadings proposed for the eye-bar bridge and recommended by the commission of engineers appointed during the preceding year were, however, retained in the new wire cable design.

The following comparative table will show the changes in plans:

	Original Cable Design.	Eye Bar Chain Design.	Final Cable Design.
Length of Main Span	1,475 feet	1,470 feet	1,470 feet
Length of Side Spans, each	850 feet	725 feet	725 feet
Length of Brooklyn Approach	4,230 feet	5,414 feet	1,935 feet
Length of Manhattan Approach	1,948 feet	2,068 feet	2,068 feet
Clear Height above M. H. W. Max. Temp. and worst Condition of Loading for 200 feet each side of centre of bridge	135 feet	135 feet	135 feet
Height above M. H. W. of centre of Cable over Towers	323.4 feet	349.7 feet	322.5 feet
Width of Bridge over all	120 feet	125 feet	120 feet
Number of Trolley Tracks	4	4	4
Number of Elevated Tracks	2	4	4
Roadway Flooring	Creosoted timber underflooring with spruce or tamarack wearing surface	Creosoted blocks on concrete and buckle plates	Creosoted timber underflooring with creosoted block wearing surface.
Style of Bridge	Wire Cables with Suspended Trusses	Eye Bar Chains and Spandrel Bracing	Wire Cables with Suspended Trusses.
Working Live Load	4,500 lbs. per linear foot.	8,000 lbs. per linear foot.	8,000 lbs. per linear foot.

It was originally proposed to bring the Brooklyn approach to grade at Willoughby street, between Prince and Gold streets. It was afterward decided to bring it to grade at Nassau street, between Bridge and Jay streets. From Nassau street to Flatbush avenue a street 120 feet wide was laid out, the jurisdiction over this extension of Flatbush avenue being vested in the President of the Borough of Brooklyn.

Work on the revised cable design was begun immediately upon the assignment of the staff to this work.

Messrs. Carrere and Hastings were engaged as consulting architects on this bridge April 21, 1904, and at once entered actively upon the studies of the architectural features of the design.

The changes in loading and the location of the anchorages, and the character of the tower foundations as completed made it necessary to work the plans up again from the beginning.

The plans of the main bridge were submitted to the Art Commission for approval on June 23, and by request of members of the Commission withdrawn and resubmitted on August 3, 1904, and were finally approved by that body on September 15, 1904.

On May 6, 1904, a bond issue for $10,000,000 was authorized by the Board of Estimate and Apportionment and approved by the Mayor on June 22, 1904.

Anchorages—

As soon as the controlling features of the general design had been far enough developed the contract plans for the anchorages were pushed to completion as rapidly as possible, and the contracts for both anchorages were advertised December 6, 1904, and bids were opened on December 22, 1904. The following bids were received:

MANHATTAN ANCHORAGE.

Contractors.	Manhattan Anchorage Only.	Both Anchorages.
Williams Engineering Company	$1,197,000 00	$1,197,000 00
Naughton & Co	1.296,150 00	1,296,150 00
R. H. Hood Company	1,587,460 00	1,687,460 00
J. C. Rogers	1.409,000 00	....
J. J. Hopper	1,396,140 00	1,396,140 00

BROOKLYN ANCHORAGE.

Contractors.	Brooklyn Anchorage Only.	Both Anchorages.
Williams Engineering Company	$1,237,000 00	$1,237,000 00
Naughton & Co	1,282,900 00	1,282,900 00
R. H. Hood Company	1,511,884 00	1,611,884 00
Ryan & Parker Co	1,393.000 00	....
J. J. Hopper	1,337,848 00	1,337,848 00
Kosmos Engineering Company	1,212,554 00	....

The contract for the Manhattan anchorage was awarded to the Williams Engineering and Contracting Company, and the contract for the Brooklyn anchorage to the Kosmos Engineering Company, the lowest bidders in each case.

The plans of the towers and superstructure are now being pushed to completion as rapidly as possible, it being the intention to let the towers, cables, suspended superstructure and anchorage steel in one contract.

Surveys—

Previous to December 31, 1901, the centre line of the bridge had been run out, points established and a new traverse made of each block crossed. A change in the line of the Brooklyn approach from Nassau street to Flatbush avenue made it necessary to establish a new centre line between these points. This new line crossed a number of blocks not touched before, of which surveys were made as to street lines during the year 1903.

There are no monuments establishing street lines in the part of the city in which the approaches are located and no reliable maps showing block lengths. Owing to this fact it is necessary to make a complete survey of each parcel and make extensive searches before condemnation maps can be properly drawn.

The surveys of individual pieces of property have been practically completed from the river to Sands street on the Brooklyn side, and from the river to Monroe street on the Manhattan side.

Check triangulations were made early in 1904, finally locating the tower foundations and accurately fixing the necessary points for placing the steel work of the towers.

Acquisition of Property—

The property has been acquired for the anchorages on the Manhattan side between Water and Monroe streets, and on the Brooklyn side between the pier-head line on the river and Front street, and the acquisition of the property from Front street to Nassau street has been applied for.

Condemnation proceedings have also been begun to acquire that portion of the block on Pike slip and between Water and South streets coming within the right of way of the bridge.

Removals—

The buildings at No. 191 Cherry street, Manhattan, and the block bounded by Pearl, Front, Adams and Water streets, in

Brooklyn, were sold at public auction late in the year 1903, and removed early in the year 1904. Other buildings on the property acquired for the anchorages will be removed as part of the contracts for constructing the anchorages.

These buildings were removed by October 15, 1904.

CONSTRUCTION.

Brooklyn Tower Foundation.

The contract for the Brooklyn tower foundation was awarded to John C. Rodgers for $470,000, and was duly executed May 1, 1901.

On February 17, 1902, the caisson, which was built in the Harlem river, at One Hundred and Forty-ninth street, was towed to place at the tower site, the necessary dredging to a depth of about 41 feet below M. H. W. having been completed.

Five tugs were required to tow the caisson down, which was accomplished in about five hours. The height of the caisson was then 43.31 feet above cutting edge, or 34 feet above roof.

Some time was required to complete the contractor's plant, however, and the actual work of placing concrete and sinking the caisson was not begun until March 26, 1902. From that time work proceeded almost without interruption until June 11, 1902, when all the concrete above the deck was in place. On April 16, the caisson grounded on soft river mud, and on April 28 air was admitted to the working chamber. After the completion of the dredging considerable river mud had washed in, especially on the shore side, and the cutting edge rested at an average depth of 38.65 feet below M. H. W. Five days after work began in the chamber, however, the caisson was practically level and not more than 1½ inches out of position in any direction.

No difficulty was experienced in keeping it practically in correct position, and it was finally landed with the cutting edge at elevation 91.85 feet below M. H. W., the west end 4⅞ inches out of line, the east end and the two sides by less amounts. Since the plans provided for offsets of about 3 feet on all sides, there was no difficulty in building the masonry to correct lines.

When the caisson grounded at elevation 38.65 below M. H. W. there had been placed in the caisson about 4,800 cubic yards of concrete. On August 8 seven courses of limestone masonry had been laid, a total of 5,898 cubic yards, together with 16,574 cubic

yards of concrete, and the cutting edge was at elevation 91.85 below M. H. W. The material at this depth consisted of coarse gravel and boulders, cemented together sufficiently to require a pick to loosen it. This material overlies the rock to a depth of 2 or 3 feet, and is nearly as good as concrete. It was therefore deemed unnecessary to carry the excavation further, and accordingly the work of concreting the working chamber was begun.

It required 2,562 cubic yards of concrete to fill the working chamber, which was placed in ten days, working sixteen hours a day.

About this time certain supplemental agreements were made with the contractor, and in accordance therewith the pedestal blocks and steel grillage, provided in the original contract, were to be omitted, and in lieu of these the two outer well holes were to be filled with concrete. These wells were filled about the same time that the granite facing was begun, and the foundation is therefore solid throughout, except for the centre well, which remains as provided in the original plans.

On December 22, 1902, after considerable delay, owing to bad weather, the foundation was completed.

The air pressure maintained throughout the sinking of the caisson was slightly in excess of the hydrostatic pressure of a column of water corresponding to the depth. Work in air began at a depth of 38.65 feet below M. H. W., with a pressure of 20 pounds. At the final depth of 91.85 feet below M. H. W. the pressure was 47 pounds.

The material passed through was approximately as follows:

Silt	5 ft.
Sand	12 ft.
Sand, with some gravel and boulders	28 ft.
Gravel and boulders	9 ft.

The number of hours per day that the men worked in the air varied with the depth and pressure from eight hours at the beginning to 2 hours at the maximum pressure. Several cases of caisson disease, or "bends," occurred, most of which occurred while the men were working four hours a day at a depth of from 70 to 80 feet below M. H. W. Three of these cases proved fatal, being the only serious accidents during the entire construction of this foundation.

The total price paid for this contract was $470,000.

Manhattan Tower Foundations—

On December 11, 1902, bids were received for the construction of the Manhattan tower foundation. The bids received were as follows:

Contractor.	Total Bid.
J. C. Rodgers	$482,726 56
John G. Tait	512,726 56
D. D. McBean	574,415 00
Degnon-McLean Company	902,032 40

The contract was awarded to Mr. John C. Rodgers, the lowest bidder, who had built the Brooklyn tower foundation. By the terms of the contract the caisson was to be sunk to a minimum depth of 79.15 feet below M. H. W. and the tower foundation built complete for the sum of $450,000, or if the caisson was carried to 103 feet below M. H. W. the amount to be paid was $482,726.56. Unit prices covered the work between these limits.

On March 12, 1903, the contractor began the construction of the caisson. The same method of constructing the caisson on pontoons, followed in the case of the Brooklyn caisson, was adopted.

On May 28, 1903, the caisson was launched, and on July 27, in tow of five tugs, it left the slip at One Hundred and Forty-ninth street.

After considerable difficulty with unfavorable tides, at 7 P. M. July 29, the caisson was tied up in position at the foot of of Pike slip.

Considerable time was required to complete the contractor's plant before the work of sinking the caisson could be begun, and it was not until August 11 that the first concrete was deposited in the caisson. On August 31 the caisson grounded.

Originally an old pier stood on the site of this tower foundation, and when the dredging for the foundation was done a large amount of rip-rap cribbing and piles was not removed, and it was upon this material that the caisson landed, at a depth of about 40 feet below M. H. W.

Most of this material had to be removed by buckets, which made progress at first very slow. Air was put in September 17, and after a month's work sand began to appear in the bottom, and nearly all the coarse material, of which there was about 7 feet, had been removed. On November 20 the cutting edge had reached elevation 68.50 feet below M. H. W., all the concrete

above the deck had been added and the limestone masonry was begun.

By December 1 three courses of limestone masonry had been laid and the cutting edge was at elevation 76 below M. H. W. An examination of the bottom made at this time showed sand and gravel, together with a few small boulders. In general, the sand was coarse, clean and sharp, and comprised 70 or 75 per cent. of the whole. The gravel was principally fine and varied from ¼ inch to 1½ inches in diameter.

The material was well compacted, but was not deemed by the Commissioner of Bridges sufficiently solid to insure against lateral movement and consequent settlement, should the adjoining material be disturbed at any time in the future.

Therefore, since the original borings showed little if any improvement in the quality of material at any point above the rock, it was decided at this time to continue the excavation at least as deep as on the Brooklyn side, viz., 91.85 feet below M. H. W. Accordingly the cofferdam was built up and more masonry added.

This latter consisted of limestone on the face of the wall and about the well with concrete backing.

On December 31, 1903, excavation was stopped with the cutting edge at an elevation of 92.26 feet below M. H. W.

At this time eleven courses of limestone masonry had been laid above the concrete footing, and the top of the masonry was at an elevation of 13.76 feet below M. H. W. In order to prevent further settlement of the caisson, concrete was first placed under the bulkheads and cutting edge, which work extended from January 1 to January 6, inclusive.

On December 31, 1903, a supplemental agreement was entered into with the contractor for the purpose of impregnating the foundation material with grout forced through pipes. Work was begun under this agreement January 1 and continued until January 18, when the sealing of the working chamber was begun.

During this period a thorough examination of the soil was made by digging test pits, and also by testing the bearing power of the soil with a hydraulic jack.

The material at this depth consisted, over the greater portion of the area, of about 75 per cent. sand and 25 per cent. gravel and boulders. There were but few boulders and these were generally about 2 feet in diameter. The gravel was nearly all fine.

On the shore side of the caisson, over perhaps about 20 per cent. of the entire foundation, there was a very fine sand, with a tendency to quake when wet. This latter material extended down to a depth of about 4 feet, near the cutting edge at the centre of the shore side, and gradually disappeared near the east and west ends of the caisson.

When an effort was made to force grout into the foundation material practically nothing could be accomplished. Two-inch wrought-iron pipes, with ¼-inch perforations in the sides and fitted with points, were driven with mauls as deep as possible, and an attempt then made to force grout into the sand through the perforations in the pipes with a pressure of 150 pounds per square inch. Practically no grout could be forced into the sand.

The character and great depth of the bottom were such that it was decided to be safe to let the foundation rest on it as it was.

The work of attempting to force grout into the material of the bottom was, by the supplemental agreement, paid for on a basis of cost of labor and material, plus 25 per cent for use of plant and profit. The total cost was $20,767.10.

On January 29, 1904, when there were but 3 or 4 yards more of concrete needed to complete the sealing of the working chamber, a fire started at the foot of a shaft. The air was taken off, the caisson flooded and the fire extinguished without difficulty or material damage.

The working chamber was completely sealed January 30. The shafts were all filled by February 4. All the masonry of the tower foundation proper was laid by March 31.

The air pressure during sinking was maintained at about hydrostatic pressure.

A few cases of " bends " developed, of which two were fatal.

The docks, cofferdams, etc., were removed on both sides and the tower foundation sites cleared up early in September. The final estimate was allowed for the Brooklyn tower foundation on September 7, and for the New York tower foundation on September 10, 1904.

MASONRY PEDESTALS.

The masonry pedestals consist of four moulded courses of masonry with granite facing and tops and limestone backing,

adding about 11½ feet to the height of the foundations. Bids for this work were opened on April 9, 1903. These were as follows:

John C. Rodgers	$150,000 00
Thomas Dwyer	168,618 00
Ryan & Parker	182,000 00
Edward J. Farrell	190,450 00

The contract was awarded to John C. Rodgers, the lowest bidder, and the contract was executed on July 9, 1903.

The Brooklyn pedestal was begun July 30, 1903, and was finished October 19, 1903, except for some hand dressing on top, and drilling the anchor bolt holes, which was done later.

The tops were dressed to accurate level surfaces first by machine and then by hand.

MANHATTAN BRIDGE BROOKLYN TOWER FOUNDATION.

The Manhattan pedestal was begun April 2, 1904, and completed May 13, except for top dressing and drilling anchor bolt holes. The top dressing was done in the same manner as on the Brooklyn side. Thirty-two anchor bolt holes, 3 inches in diameter and 11 feet 6 inches deep, were drilled in each pedestal. This work was begun June 24 and was completed August 20, 1904.

Settlement—

On the Brooklyn tower foundation no appreciable settlement occurred after the caisson was sealed.

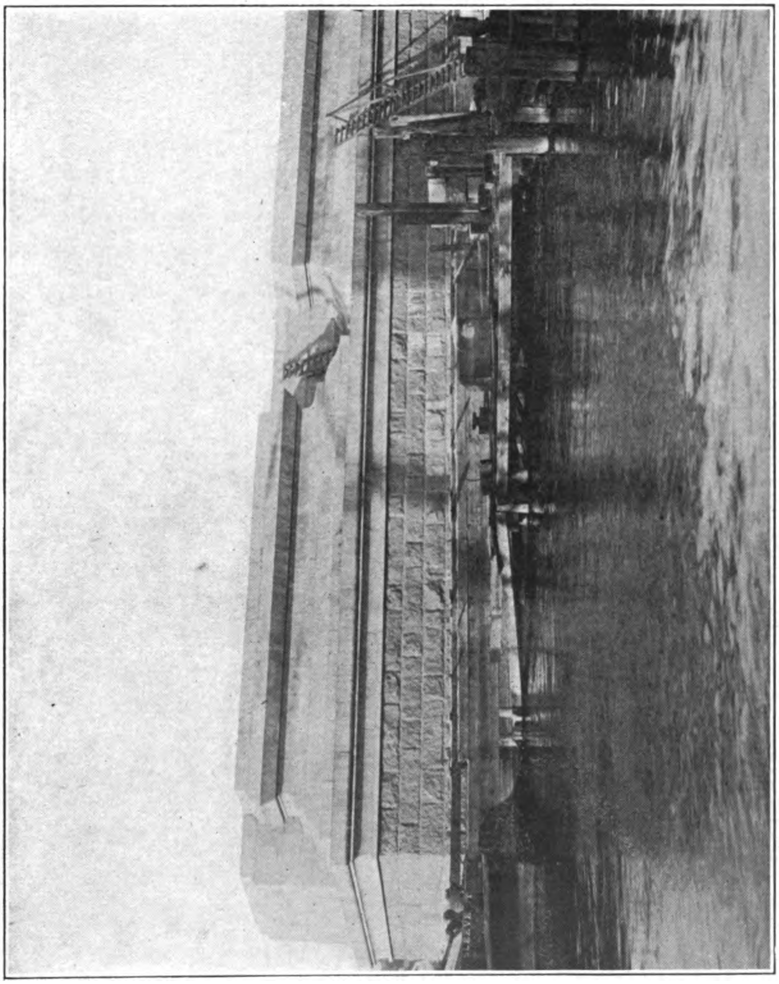
On the Manhattan tower foundation an average settlement of one inch was observed from February 2, 1904, after the caisson was sealed, to June 15, 1904, since which time no appreciable settlement has occurred. The load at the bottom of the foundation is now somewhat more than one-half the maximum load that can come on it.

Additional Wash Borings on Anchorage Sites—

On account of the change of location of the anchorages embodied in the change of plans made in 1902, which location was subsequently adhered to, it was decided early in 1904 to make additional wash borings, to ascertain more closely the character of the bottom on the anchorage sites.

Three borings were made on the Manhattan side and three on the Brooklyn side. These agreed closely with the borings previously made.

The work was done on order for a price of 50 cents per foot on the Manhattan side, and $1 per foot on the Brooklyn side.



COMPLETED TOWER FOUNDATION, MANHATTAN BRIDGE, FOOT WASHINGTON STREET, BROOKLYN.

The aggregate cost of this work was $130.75 for the Manhattan side, and $222 for the Brooklyn side.

The original plans for the Manhattan Bridge were approved by the Secretary of War on January 29, 1900. The additional loading imposed on the structure and the change of the plans required a resubmission of the plans to the Secretary of War, which was made in August, 1904, and his approval of these plans is submitted herewith (Appendix D).

FINANCIAL STATEMENT.

The following amounts have been expended on the Manhattan Bridge to January 1, 1905:

Brooklyn tower foundation	$470,000 00
Manhattan tower foundation	503,443 90
Masonry pedestals on towers	150,000 00
Property, Manhattan	922,055 39
Property, Brooklyn	1,684,538 80
Borings on tower and anchorage sites	18,530 96
Engineering and office expenses	175,253 61
	$3,923,822 66

Respectfully submitted,

HOLTON D. ROBINSON,
Engineer in Charge, Manhattan Bridge.

BLACKWELL'S ISLAND BRIDGE (NO. 4).

O. F. NICHOLS, Esq.,
Chief Engineer, Department of Bridges:

DEAR SIR—On December 31, 1901, the general plans for this bridge had been adopted, the stresses computed and many preliminary studies developed. The contract for the substructure had been let and the work was well under way on Piers 2 and 3.

Original Plans—

The original plans were for a bridge of the following capacity:

Two elevated tracks.
Four trolley tracks.
Two centre roadways 18 feet 10 inches wide.
Two outside footwalks 11 feet wide.
Width of bridge, centre to centre of trusses, 93 feet.
Width of bridge over all 120 feet.

The roadways, trolley tracks and footwalks were at the same level on the lower floor, and the two elevated tracks were on the upper floor.

Revised Plans—

Early in the year 1902 it was decided to change the design of the bridge, making the capacity as follows:

Two elevated tracks.
Two trolley tracks.
One roadway 44 feet wide.
Two footwalks 11 feet wide.
Total width of bridge 80 feet.
Width, centre to centre of trusses, 50 feet.

The two trolley tracks and roadway were at the same level on the lower floor. The elevated tracks and footwalks were at the same level on the upper floor.

The two trolley tracks were to be carried on brackets outside the trusses, the rest of the system being inside the trusses.

Owing to serious opposition being made to the omission of two of the trolley tracks, it was then proposed to put these back, placing them just inside the trusses and narrowing the roadway to about 24 feet.

Upon these lines the plans were being prepared when, on July 25, 1902, the Board of Estimate and Apportionment directed that an easement be taken over the property of the New York Steam Company on the river front, between Fifty-ninth and Sixtieth streets, instead of acquiring this property and placing Pier 1 thereon, as originally contemplated. This necessitated moving Pier 1 51 feet back from the river, lengthening the west channel span by that amount, and required the reproportioning of the entire structure.

Strong opposition having been made by the citizens of the Borough of Queens, represented by the organization known as the Committee of Forty, to the proposed changes in the Blackwell's Island Bridge plans, and especially to the reduction in width, which objections were filed in this Department, in a printed pamphlet dated September 25, 1902, and brought before the Mayor at a public hearing on October 21, 1902, a commission of experts was appointed, one member being selected from a list presented by this Department, another from a list prepared by the Committee of Forty and the third chosen by the other two.

This Commission submitted its reports under dates December 10 and 13, 1902, and January 5, 1903 (Appendix E).

The summary of the recommendation of the Commission as to the capacity of the bridge was as follows:

Two elevated tracks.
Four trolley tracks.
Two footwalks 11 feet wide on upper floor.
One roadway 36 feet wide between curbs.
Width of bridge, centre to centre of trusses, 60 feet.
Width of bridge over all 91 feet.

The centre to centre width between trusses was fixed by the space required between the trusses and tower legs to clear the trolley cars on the outside tracks.

New computations and plans were then made, embodying the recommendations of the commission of engineers.

The plans prepared by Mr. Henry F. Hornbostel, the Consulting Architect, were presented to the Art Commission and approved by that body February 10, 1903.

The plans as finally prepared fixed the out to out width of bridge as 86 feet.

Masonry Piers—

The contract for the six masonry piers of the main bridge was let to Ryan & Parker June 27, 1901, for the lump sum of $745,547, to be completed in 500 working days.

Six supplemental agreements were made to this contract, covering changes in the work required by the changes in plans.

The *first* supplemental agreement was executed December 30, 1901, covering the change of location of Pier III., on the east side of Blackwell's Island, 38 feet eastward.

The additional work on the foundation of Pier III. required to effect the change was done on force account, plus 15 per cent. for use of plant and profit to contractors. Under this arrangement the cost of the additional work was $4,191.82.

The *second* supplemental agreement was made to embody certain modifications of detail in the six masonry piers recommended by the Consulting Architect. This did not involve any additional cost to the City. The second supplementary agreement was executed July 26, 1902.

The *third* supplemental agreement was executed October 8,

1902, covering provisions for stairway and elevator shafts in the anchor piers for pedestrians.

This supplemental agreement involved no extra expense to the City, beyond the increased cost of the foundations at unit prices provided in the original contract.

The *fourth* supplemental agreement, executed December 1, 1902, provided for moving the location of Pier 1 51 feet westward, to avoid condemnation of the New York Steam Company's plant, in compliance with the resolution passed by the Board of Estimate and Apportionment.

This agreement involved no additional cost to the City, except for a small amount of extra work required in the construction of a retaining wall between the main shafts of the piers.

The *fifth* supplemental agreement was required to cover the changes required by the recommendation of the commission of engineers, submitted December 10, 1902.

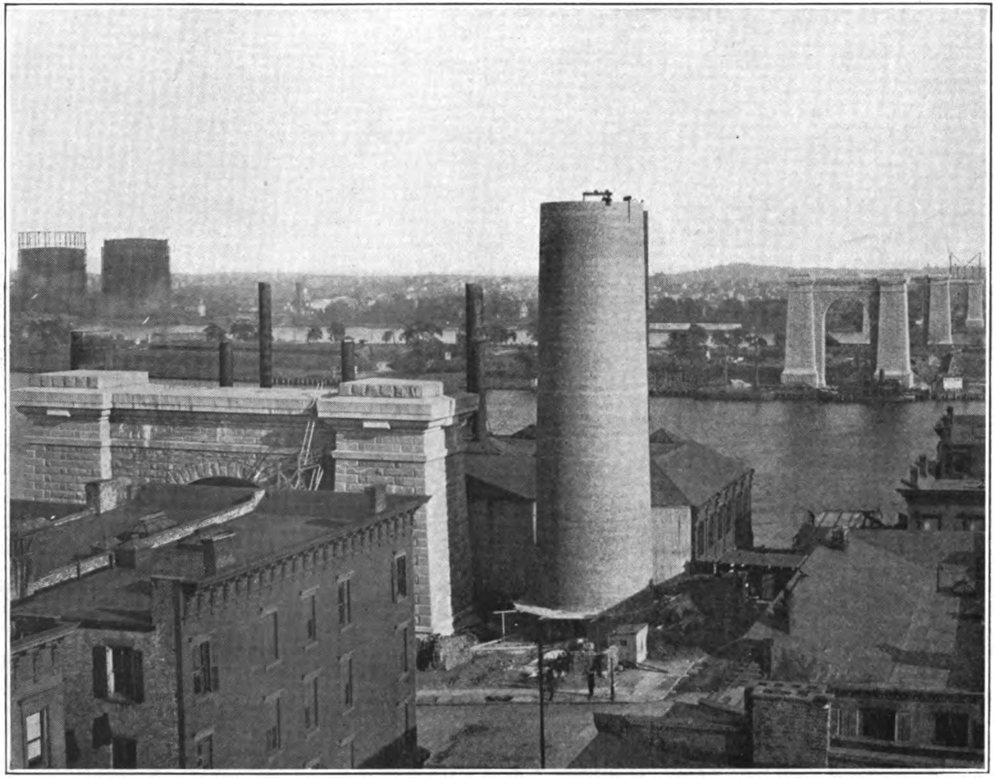
Negotiations were opened with the contractors for the purpose of making this supplemental agreement, but, owing to the far-reaching effect of the changes and the demands of the contractors, no agreement could be reached, except to refer the matter to arbitration. Accordingly, the Commissioner of Bridges named Mr. Samuel Whinery, Consulting Engineer, and the contractors named Mr. John F. O'Rourke, engineer and contractor, as arbitrators, with power to name a third in case of disagreement. The arbitrators, after considering the matter, filed their report August 10, 1903.

In accordance therewith, on August 20, 1903, supplemental agreement No. 5 was executed, and, in order to simplify matters, this agreement was made to cover all of the changes provided for in the four previous supplemental agreements. The lump sum price for the entire work was fixed at $842,340, plus the cost of any increased depth of foundation for the west anchor pier, at specified unit prices, and extending the time of completion to March 1, 1904.

The *sixth* supplemental agreement was executed October 15, 1903, for supplying two steel water-tight boxes for protecting the anchor girders of the west anchor pier, at a cost of $2,000.

The work on the piers covered by the Ryan & Parker contract was finally completed June 10, 1904.

The total amount paid for this contract was $858,565.01.



EAST RIVER BRIDGE NO. VI., BLACKWELL'S ISLAND.—MASONRY PIERS.

Attics, Elevator Shafts, Power Houses and Towers—

Bids were received on December 21, 1903, for attics, elevator shafts, power houses and towers, and the contract was awarded to the Williams Engineering Company for $685,000, and the contract therefor executed on December 31, 1903. Contract time for completing work was 300 working days.

On account of the contract with the Pennsylvania Steel Company for the superstructure, previously executed, it is impracticable to build the power houses and elevator shafts on Blackwell's Island until after the completion of the island span and the island cantilever arms; and impossible to begin the attics until after pier members have been placed. The attics cannot be completed until after the island span and cantilever arms are completed and a large amount of dead load therein applied.

Therefore, the only part of their contract that the Williams Engineering Company can perform prior to the completion of the island span and a large part of the island cantilever arms is the work on the anchor piers, which is 15 per cent. of their entire contract. Work was begun by the Williams Engineering Company about July 1, 1904, and about 33 per cent. of the work on the anchor piers, or 5 per cent. of the entire contract, has now been completed.

Borings—

Wash borings have been made along the line of the Queens approach, for the purpose of determining the probable depth of foundations for this part of the structure.

These borings extend from the east anchor pier to Crescent street.

Surveys—

On the Manhattan side surveys have been made of all the street lines of property to be acquired, from the river to Second avenue.

Complete surveys have been made of the property acquired for the west anchor pier and Pier I., also of the remaining property between the west anchor pier and Avenue A.

On the Queens side the centre line has been run out and its intersections with street lines located.

Complete surveys have been made of property acquired from the river to just east of the east anchor pier.

The final check traingulation has been made for definitely locating the six piers of the main bridge, and all necessary points established for locating the steel work thereon.

Acquisition of Property--

Property has been duly acquired for the construction of the piers, and proceedings are now under way for the acquisition of the property between the west anchor pier and Avenue A, on the Manhattan side, some pieces being obtained by purchase.

An easement in perpetuity was acquired over the property of the New York Steam Company, by order of the Board of Estimate and Apportionment; a contract to this effect being executed by the Commissioner of Bridges and the New York Steam Company July 24, 1903.

This easement was granted for the sum of $40,000 paid the New York Steam Company, to cover the cost of the erection of a chimney 300 feet high and the alterations made necessary in their plant to properly carry off smoke and gases above the highest point of the bridge.

Superstructure—

Bids were received for the steel superstructure on September 24, 1903, on a pound price basis. One bid was received from the Pennsylvania Steel Company, for an estimated total sum of $5,324,269.

This bid was rejected by the Commissioner of Bridges and the contract readvertised, after some material modifications were made in the specifications.

Bids were again received on November 5, 1903, there being two bids, as follows:

	Total Est. Cost.
Pennsylvania Steel Company..................	$5,132,985 00
Milliken Brothers	5,188,850 00

On November 9, 1903, the contract was awarded to the Pennsylvania Steel Company and executed on November 20, 1903.

On January 1, 1904, no material progress had been made in the preparation of detail or working plans.

Some modifications had been made in the contract plans, chiefly in connection with the floor system of the island span.

A review of the plans was made as rapidly as possible and certain changes were made in the structural details, to provide the necessary strength and rigidity in the structure. Also pro-

vision was made for putting two additional elevated tracks on the bridge should this be found desirable.

The detail drawings were developed and the first shop drawings for the island span finally approved July 8, 1904.

The first material was rolled and shipped to the shop about September, 1904.

Shop work was begun on the permanent structure about September, 1904.

The first material for the permanent structure will be shipped from the bridge shops in a few days.

One of the largest features of this work and one involving most careful and elaborate planning and preparation is the erection plant.

The falsework is steel, all of which has been manufactured, and a large portion of which has been shipped and received at the bridge site.

The power plant has been installed on Blackwell's Island and the plant for handling and storing material has been in working order for some time.

Much delay has occurred from the unusually severe winter, not only on account of consequent difficulty of operation on the ground, but on account of serious delays in freight transportation from the same cause.

However, matters are in such shape that as soon as weather permits rapid progress can be made with construction.

Plans and specifications were prepared by the Consulting Architect for the erection of elevator towers, power houses, etc., as additions to the completed masonry of the bridge piers, and bids were opened for this work on December 21, 1903, with the following results:

The Snare & Triest Company	$860,900 00
John Pierce	887,500 00
Ryan & Parker Construction Company	777,777 00
Williams Engineering and Contracting Company	685,000 00
R. H. Hood Company	795,000 00

On December 31, 1903, the contract was awarded to the Williams Engineering and Contracting Co., the lowest bidder.

The contractor commenced work on the anchor piers on June 29, 1904. The work on the elevator towers of the main piers cannot be prosecuted while the erection of the steel work is in progress, and this work will have to be delayed for a year or more on this account.

The construction of the attics on the main piers must, however, be done at the same time that the first steel work on these piers is being erected.

Expenditures to January 1, 1905.

Property—Manhattan	$507,606 31
Property—Queens	92,904 07
Easement over New York Steam Company plant	22,000 00
Six masonry piers for main bridge (Ryan & Parker contract)	860,074 86
Elevator shafts, power-houses, attics, etc. (Williams Engineering Company contract)	29,112 50
Steel superstructure (Pennsylvania Steel Company contract)	62,342 32
Borings	15,004 49
Enginering and office expenses	163,579 06
	$1,752,623 61

Respectfully submitted,

JOHN D. WILKENS,
Engineer in Charge, Blackwell's Island Bridge.

Bridges Over the Harlem River and in the Borough of Manhattan.

December 31, 1904.

O. F. Nichols, Esq.,
Chief Engineer, Department of Bridges:

Dear Sir—In compliance with your order, I take pleasure in presenting the following summary of my reports on the bridges over the Harlem river and in the Borough of Manhattan during the years 1902 to 1904, inclusive.

The bridges maintained or under construction are, with the addition of One Hundred and Forty-fifth Street and University Heights bridges, the same as enumerated in my report to the Chief Engineer dated November 30, 1901, viz.:

1. Willis Avenue—Drawbridge.
2. Second Avenue—Suburban Rapid Transit Railroad—Drawbridge. The public has the right to use the sidewalks, which were built and are maintained by the railroad company.
3. Third Avenue—Drawbridge.
4. Madison Avenue—Drawbridge.
5. One Hundred and Forty-fifth Street—Drawbridge.
6. Macomb's Dam—Drawbridge.
7. New York and Putnam Railroad—Drawbridge. The public has the right to use the sidewalks, to one of which the City has built and maintains approaches.
8. Washington—Fixed bridge.
9. University Heights—Drawbridge.
10. Ship Canal—Drawbridge.
11. Farmers'—Fixed bridge.
12. Broadway—Fixed bridge.
13. Kingsbridge—Fixed bridge.

CONSTRUCTION.

No. 1—Willis Avenue Bridge—

An approach to Willis Avenue Bridge from the Southern Boulevard, which will make the bridge easily accessible from the large and growing section of The Bronx to the north and east, was planned in 1899, at an estimated cost of $300,000. It was considered that such a structure, though architecturally beautiful, was unnecessarily elaborate and expensive, and the plans have been revised so as to provide a handsome approach in harmony with the existing bridge, the cost of which, including the engineering expenses, was estimated at $157,000.

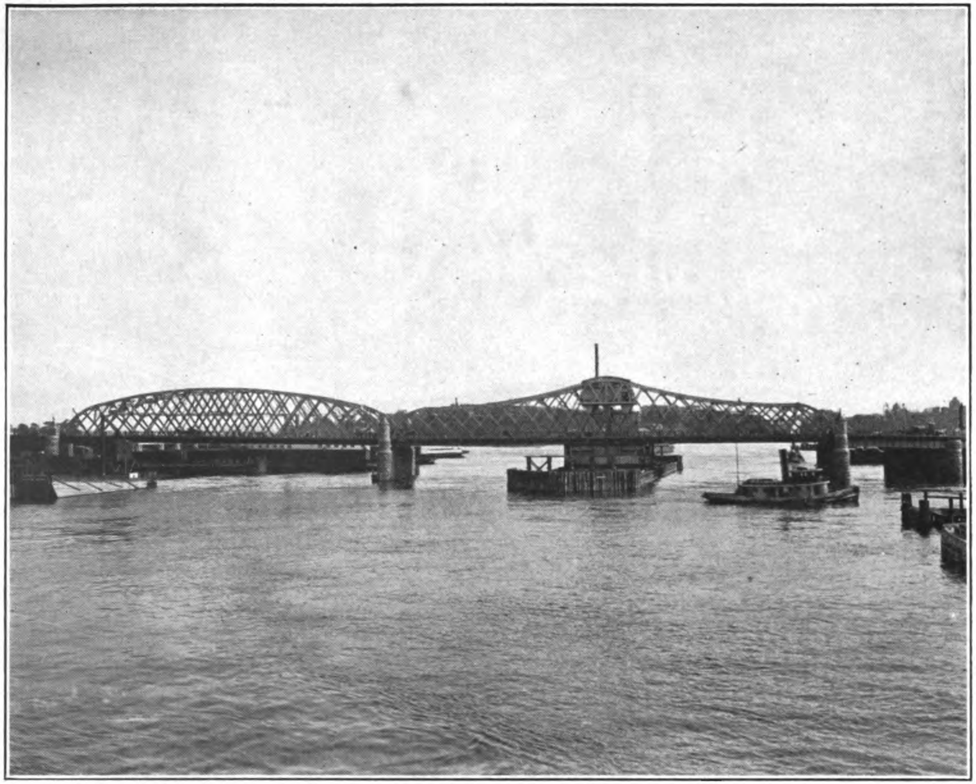
A contract for the work was awarded to the lowest bidder, Joseph Gallo, June 7, 1904, and executed June 23, 1904. The estimated cost of construction at the contract prices is $116,748, and the work will undoubtedly be completd during the season of 1905.

No. 3—Third Avenue—

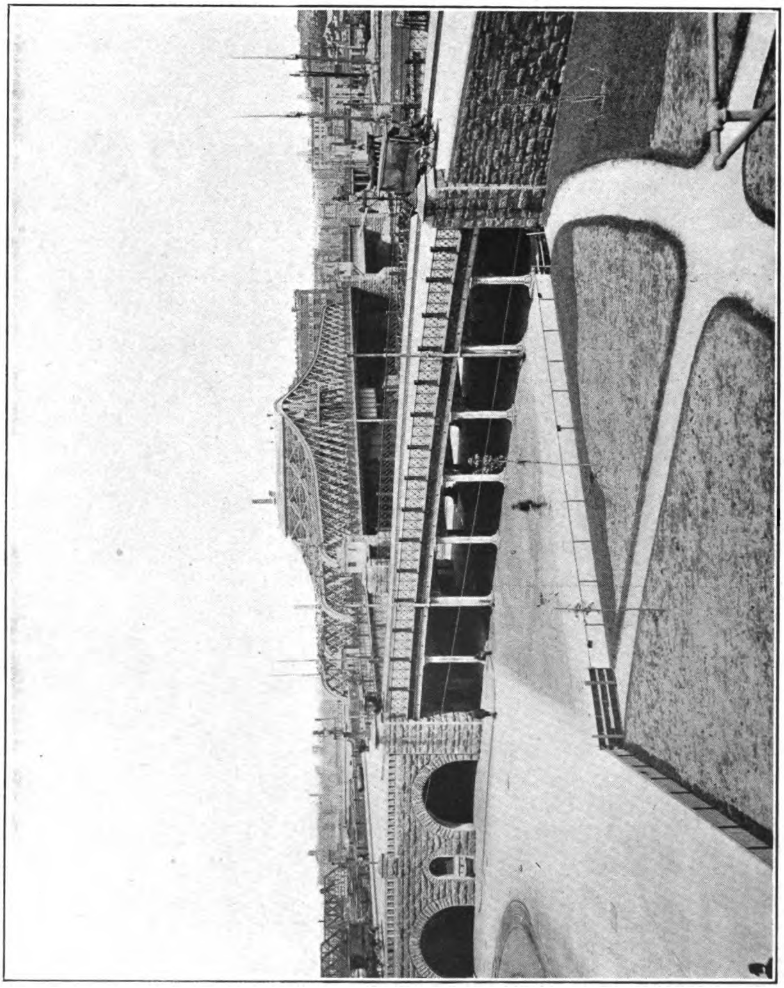
No construction has been undertaken on this bridge since the completion of the sidewalks on the western and northern approaches in January, 1902. These sidewalks have been a great convenience to the public. They were completed by the contractor, William G. Leeson, in 113 days, or 12 days less than the contract time, at a cost of $15,663.12, which was $1,110.13 less than the cost estimated at the contract prices.

No. 4—Madison Avenue—

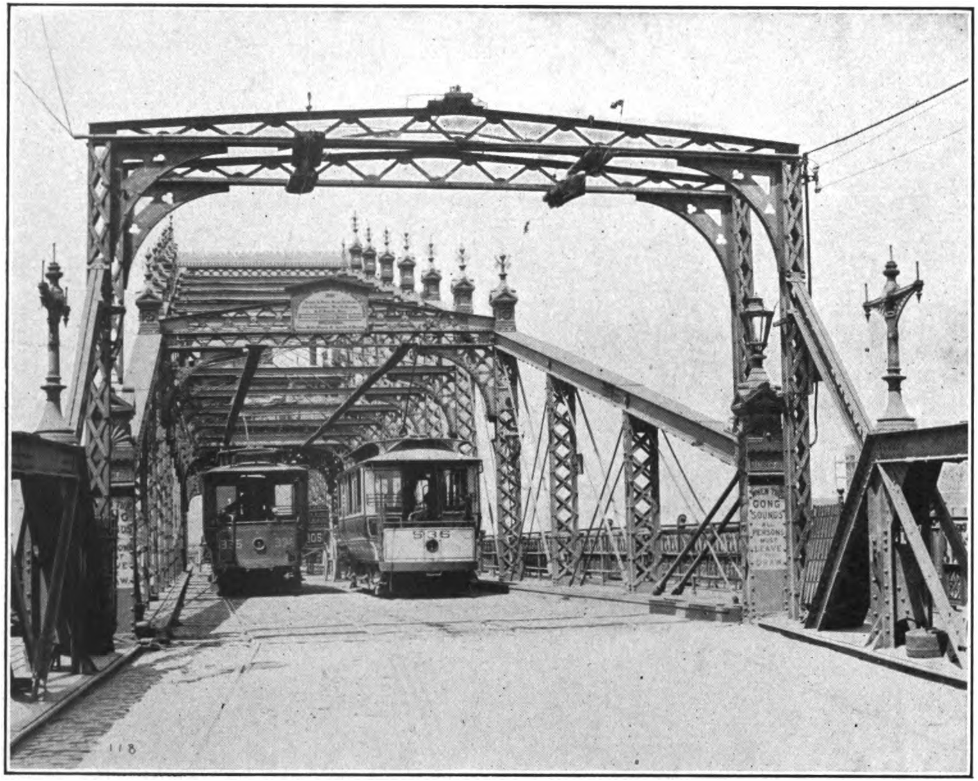
Land for approaches to a new bridge is being acquired and an appropriation of $150,000 for beginning work is now available. A general plan, including a temporary bridge to accommodate travel while the new bridge is building, has been prepared and submitted informally to the War Department for approval. Permission to erect a low level temporary bridge has been refused, and the possibility of a structure with 24 feet clear headroom is now under consideration.



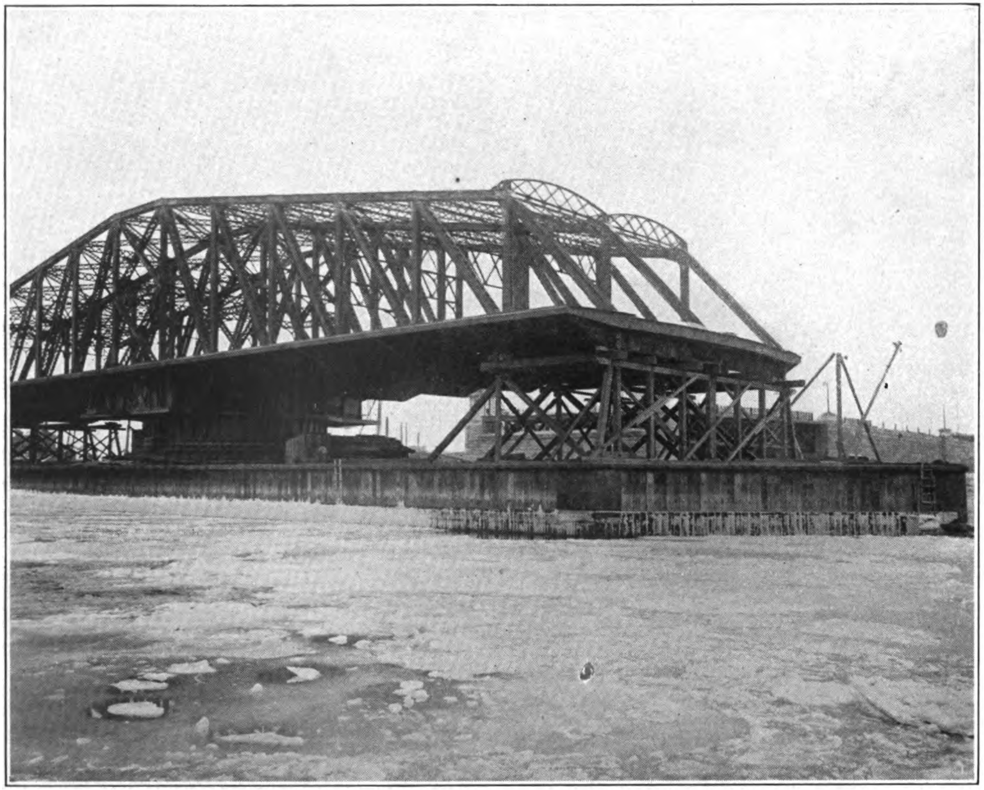
WILLIS AVENUE BRIDGE, HARLEM RIVER.



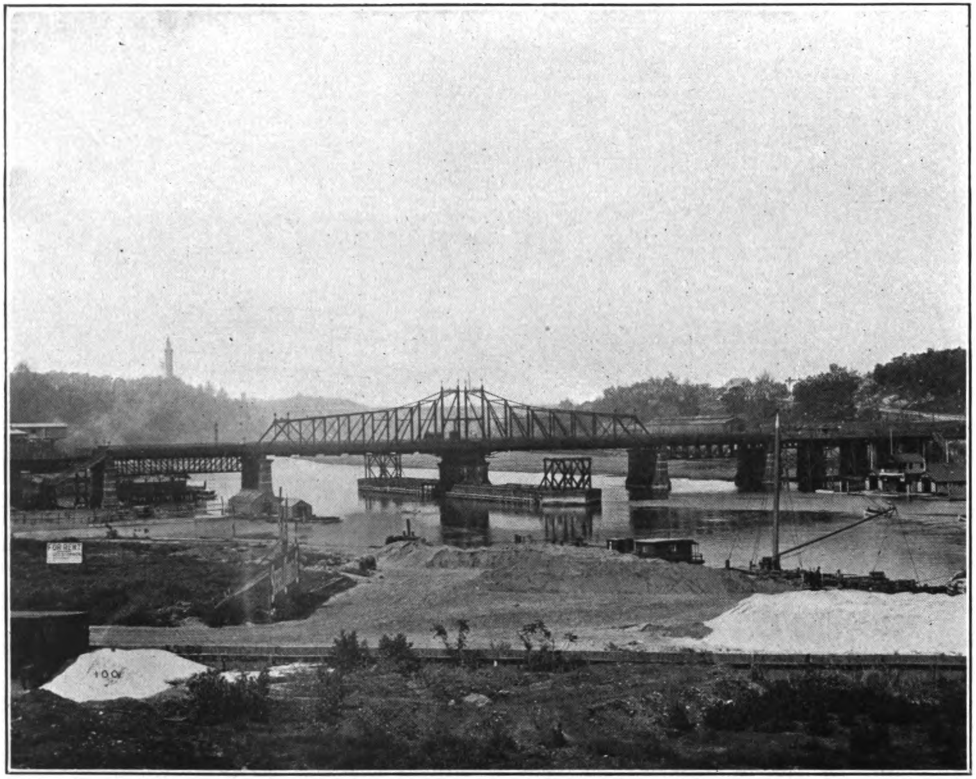
THIRD AVENUE BRIDGE, HARLEM RIVER.



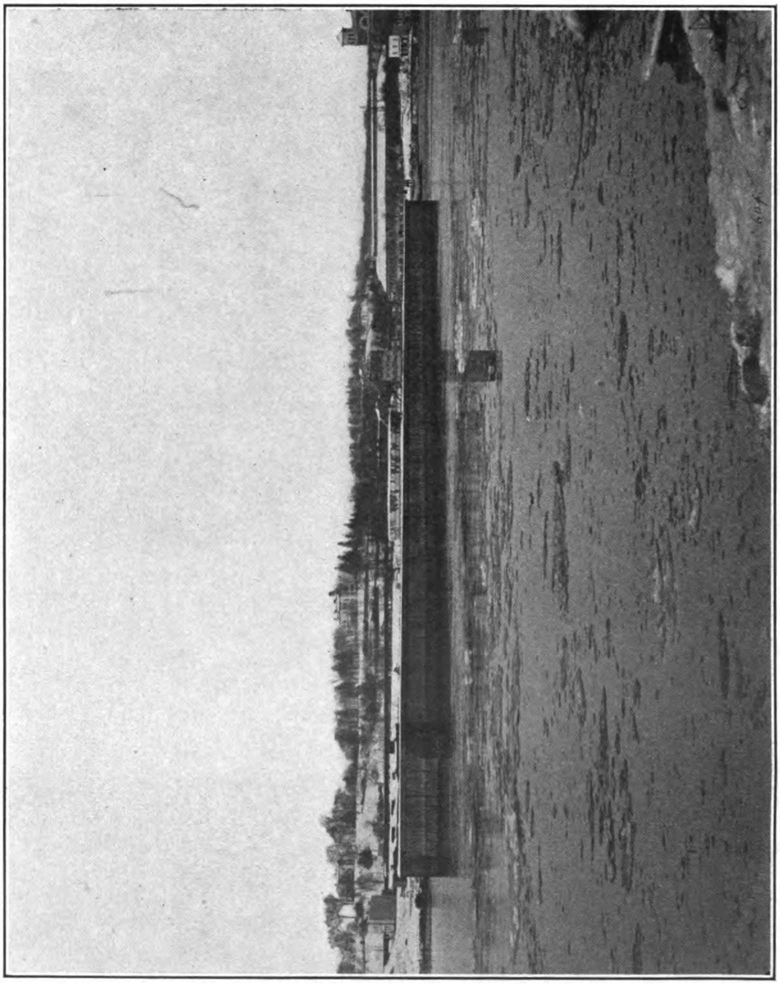
MADISON AVENUE BRIDGE, HARLEM RIVER.



ONE HUNDRED AND FORTY-FIFTH STREET BRIDGE, HARLEM RIVER.



NEW YORK AND PUTNAM R. R. BRIDGE, HARLEM RIVER.



UNIVERSITY HEIGHTS BRIDGE, HARLEM RIVER.

No. 5—One Hundred and Forty-fifth Street—

The construction of this bridge has progressed very slowly, on account of the building of the Rapid Transit tunnel under the south fender piers and adjoining the Bronx approach. No work was done on the draw span from February, 1902, to July, 1904. Since the latter date good progress has been made and the bridge will probably be opened to public travel early in the coming summer.

No. 7—New York and Putnam—

Approaches to the New York and Putnam Railroad Bridge were built by the City of New York in 1892, and were intended to be temporary. They are wooden structures, not at all ornamental, and require constant attention to keep them in safe condition, and they must be rebuilt in a short time. Since the land in the Bronx on the south side of the bridge has become part of Macomb's Dam Park and is being improved for that purpose, it will be quite appropriate to build an ornamental approach in harmony with its surroundings, and with that in view some sketches of an approach from Sedgwick avenue are being prepared in this office.

No. 9—University Heights—

The proposed bridge from Two Hundred and Seventh street, in Manhattan, to One Hundred and Eighty-fourth street, in The Bronx, called Fordham Heights Bridge, was officially named University Heights Bridge by action of the Board of Aldermen, May 24, 1904.

It was originally proposed to build a bridge from Amsterdam avenue and Two Hundred and Tenth street, in Manhattan, to the intersection of Sedgwick avenue and Fordham road, in The Bronx. It would have been 2,600 feet long, 80 feet wide and 50 feet above the river. In the interest of economy, the site has been changed to Two Hundred and Seventh street, the width reduced to 50 feet and the length to 1,250 feet.

The three spans now in use at Broadway over the Ship Canal will be brought down the river and re-erected, and under authority of an act of Legislature (Chapter 423, Laws of 1903), for the elimination of grade crossings, an agreement has been

reached between the City and the New York Central and Hudson River Railroad Company by which the latter will erect an overhead station and extend the bridge over its tracks, and the City will build or regrade the street approaches at the Bronx terminus of the bridge.

A contract for a pivot pier on pneumatic foundation, for a fender pier and for the necessary dredging was executed with the Foundation and Contracting Company, November 18, 1903, at an estimated cost of $132,566. The work was completed September 1, 1904, at a cost of $133,910.26.

Plans for the completion of the bridge and approaches have been prepared and were submitted to the Art Commission for approval December 22, 1904.

The estimated total cost of completion under these plans is $929,215. The cost to this Department of the removal and reerection of the Ship Canal spans will be $80,000.

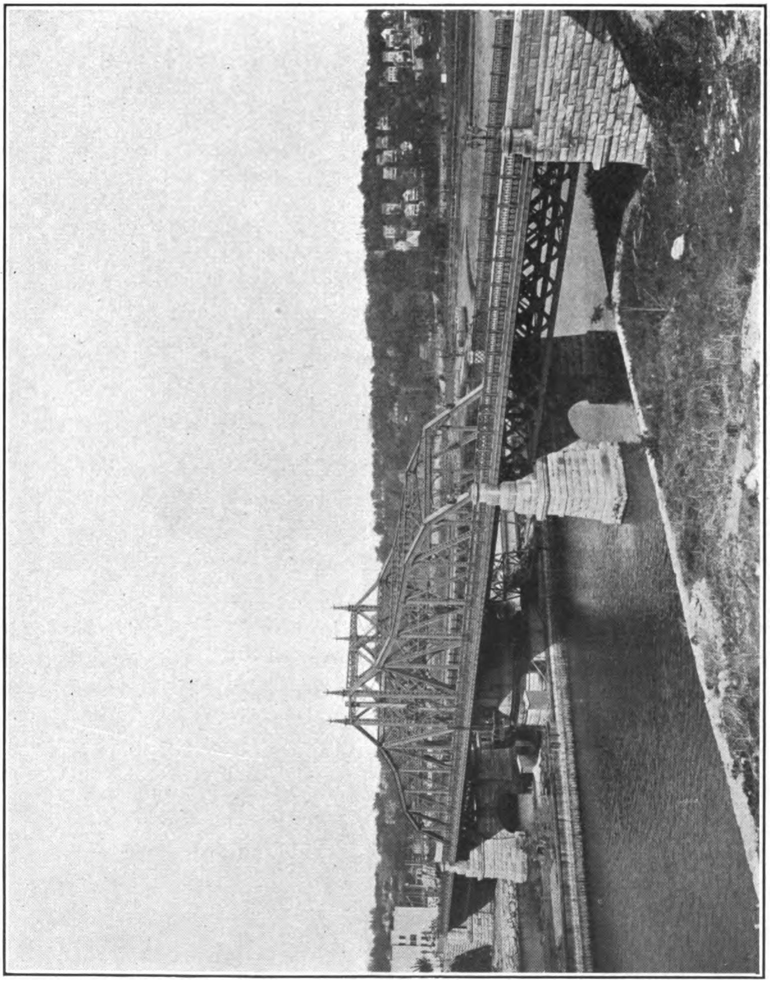
No. 10—Ship Canal—

Plans for rebuiling the superstructure on the present foundations, to adapt it to the use of the Rapid Transit Railroad and the Metropolitan surface cars, and to enable the New York Central and Hudson River Railroad to pass under the north fixed span have been prepared by the Rapid Transit Commission and approved by this Department.

A contract for the rebuilding of the bridge and the removal of the three exising spans to the new site at University Heights is about to be executed by the various parties in interest, and the first day of October, 1905, has been fixed upon as the date when the new piers shall be ready, the removal take place and the three new spans be ready to be moved into the old location at Ship Canal.

Hendrik Hudson Memorial—

It has been proposed by citizens interested in celebrating in 1909 the tricentennial anniversary of the discovery of the Hudson river that instead of building a water gate at the battery a triumphal arch or other beautiful but for practical purposes useless monument, a memorial bridge should be erected over Spuy-



SHIP CANAL BRIDGE, HARLEM SHIP CANAL.

ten Duyvil creek, near the Hudson river, in honor of the famous navigator, Hendrik Hudson, who in the year 1609 discovered and sailed up the river which bears his name.

A very fine design for a memorial bridge has been made by a well-known firm of consulting engineers for this purpose, and there would seem to be no reason why the Department of Bridges, with such excellent advisers, should not be able to construct a creditable work of art. But if the bridge is to be ready for the tricentennial celebration in 1909, there is no time to be lost in preparing for its construction.

It will not be many years before the growth of the City will, for its proper development, need a bridge in this locality, and it will form an important connecting link in the general scheme of parkways now existing or planned. It is, therefore, safe to predict that in a few years, perhaps by the year 1909, such a bridge will become a work of necessity, as well as a monument of historical and artistic value.

MAINTENANCE.

Bridges completed and under maintenance have been kept in good condition during the last three years by the Harlem river repair gang and by mechanics from the Brooklyn Bridge shops, and some special work has been done by outside machine shops. The repair gang has been strengthened and its efficiency increased by the addition of two blacksmiths, four carpenters and several bridge mechanics and helpers. A shop and store house have been built on the fender pier of Macomb's Dam Bridge, and it has been supplied with a gas engine and good outfit of tools, so that almost any kind of repairs, excepting those requiring the use of heavy machinery, can be done promptly and economically by our own men. A carpenter shop has also been established in the City building at No. 700 Southern Boulevard. During the three years most of the repair work in the Borough of The Bronx has been done by the Harlem river men, and the arrangement has given satisfaction. It therefore seems well to continue in the same way and save the expense of a duplicate organization and an additional shop and tools.

Accurate account is kept of the cost of all work, which is charged to the proper appropriation. Since September 1, 1902, a foreman and a gang of painters have been steadily employed.

A good equipment, which is renewed as parts wear out, has been furnished, and satisfactory results have been obtained.

The first important bridge painted after the organization of our painting force was the Third Avenue Bridge, which was finished May 18, 1903. The 55,500 square yards of exposed metal surface were thoroughly cleaned and painted, at a cost of 14.8 cents per square yard. The bridge had not been painted since 1899, and was in such bad condition that the foreman estimated that at least one-half the time of his men was spent in cleaning. As there is always some cleaning to be done before paint can be applied, it may be proper, in order to get a basis for comparison, to deduct from the labor cost of this work 25 per cent. on account of the unusual condition of rust. This brings the cost of painting down to about 12 cents per yard, which compares very favorably with the cost of similar work done by contract.

The Willis Avenue Bridge, which was not in bad condition, has been thoroughly cleaned and painted during the year 1904. The 86,695 square yards of surface were painted at a cost of $10,658, or 12.29 cents per yard, which is 2.71 cents per yard less than the price for which the bridge was originally painted under the contract for its construction.

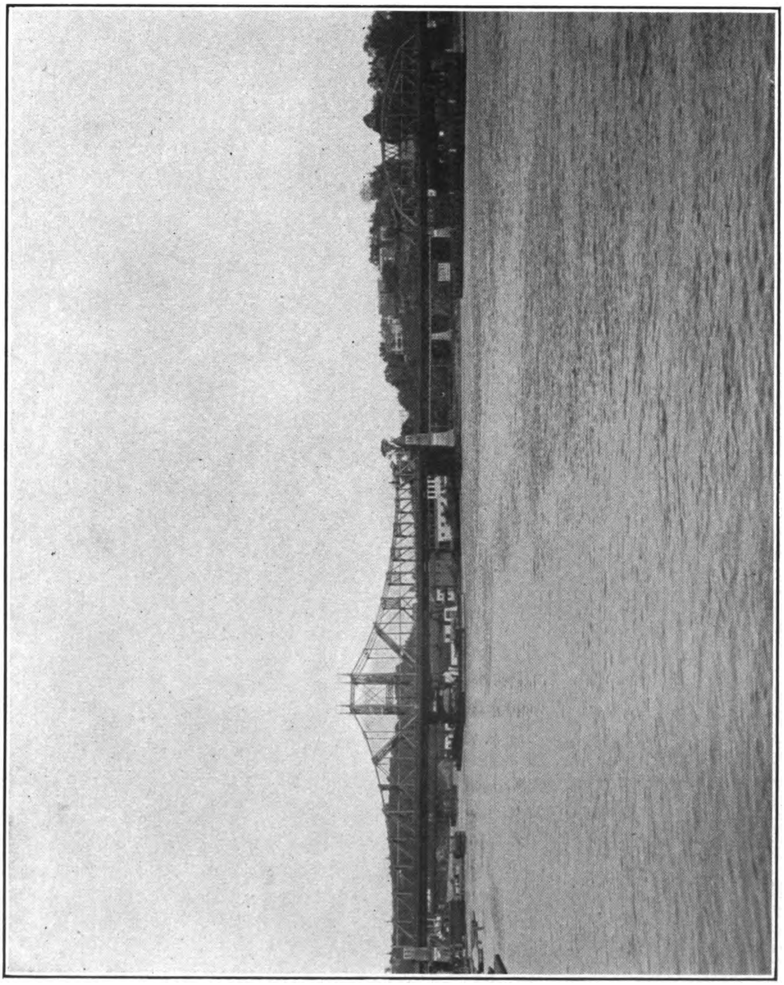
The number of painters employed depends mainly upon the amount of appropriation available, but owing to lack of funds it is never possible to employ as many men as could be worked to advantage.

The question of the proper protection by paint of these metal structures is a serious one, and, owing to the limited appropriation for maintenance, is always a difficult one to meet. It does not appear to be good economy to allow structures which have cost from one-half million to two million dollars each, and which, with proper care, should last indefinitely, to deteriorate for want of an annual expenditure of less than one-half of one per cent. of their cost.

Sheet asphalt pavements have been kept in good order at considerable expense, but as yet no form of pavement better suited to conditions on the Harlem river bridges has been found.

During 1903-1904 asphalt repairs have been made under an annual contract let to the lowest bidder for that purpose.

Alterations and improvements have been undertaken as their necessity became apparent and funds have permitted, and repairs



MACOMB'S DAM BRIDGE, HARLEM RIVER.

large and small have constantly been made as accidents have occurred or as moving parts have worn out. Among the more important items of betterment may be mentioned:

No. 1—Willis Avenue—

The differential gears of both turning engines have been removed and replaced by plain spur gears and pinions of cast steel. They have given no trouble so far, whereas the differential gears had been a constant source of expense and anxiety.

An offset of the centre pier masonry just below low water has been the cause of a number of complaints from boat owners, whose vessels have been injured by rubbing against this sharp corner.

Our submarine cables where they touch the offset have also been injured by the vessels' hulls. A shield or fender of timber has been securely fastened to the masonry, projecting slightly beyond the offset on both sides of the pier which effectually keeps boats away from the stone and from the cables. A large part of the work had to be done between tides and was tedious and expensive, but will pay for itself in saving the City from damage suits.

Materials for a fascia plate to extend the whole length of both sides of the bridge was bought in 1901 and is being erected when more pressing work does not occupy the time of our mechanics. It adds very much to the appearance of the bridge.

The whole structure was thoroughly cleaned and painted during 1904.

No. 3—Third Avenue—

The many incandescent lamps which lighted the draw span have been removed and replaced with six arc lamps, which has effected an economy in coal and better illumination. The structure was carefully cleaned and painted during 1902-'03.

No. 4—Madison Avenue—

Very little has been done to this bridge, except frequent replacing of floor planking as it has worn out.

No. 6—Macomb's Dam—

Until recently this bridge has been lighted by gas, the draw span turned by steam and its ends lifted by hydraulic rams. A careful estimate of cost showed that a saving of about $2,500 per

year could be effected by using electricity for lighting and power, and therefore the bridge has been equipped with ornamental electric light poles, lamps and cables, and is now very effectively illuminated. A twenty horse-power alternating current motor for turning the draw and raising the ends has been installed with the other necessary appurtenances and has given satisfaction as to cost of operation and efficiency. A steam-heating furnace and boiler have been placed in the turn-table below the engine-room and the latter piped and furnished with radiators. The railings of the draw span and approaches were cleaned and painted during 1903, and the whole structure is now receiving a coat of paint.

The approaches on the Bronx side of the river, crossing the swamps which is now a part of Macomb's Dam Park, have been moved bodily to the south and west by the pressure of filling placed in the swamp during the last few years. No serious harm was done by the movement, but it was necessary to move the Sedgwick avenue approach back into place. This was successfully accomplished in the spring of 1904, at the same time that the bridge and approaches were strengthened to permit the passage of the trolley cars of the Union Railway Company over the bridge.

No. 7—New York and Putnam—

The wooden truss span in the northern approach has been strengthened and made safe and floor planks have frequently been removed.

No. 8—Washington—

The elaborate iron balustrade was cleaned and painted in the fall of 1903, and, if possible, the whole bridge will be painted during the coming year.

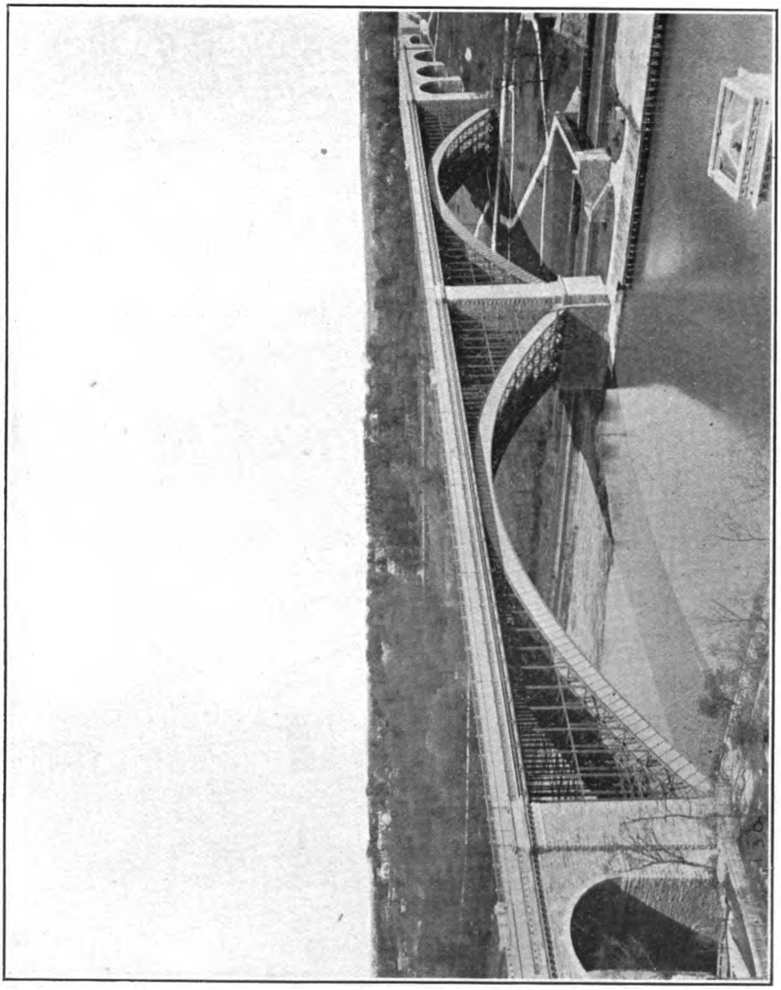
No. 10—Ship Canal—

The iron work which had not been painted since 1898 and was in very bad condition was properly cleaned and painted during the latter part of 1903.

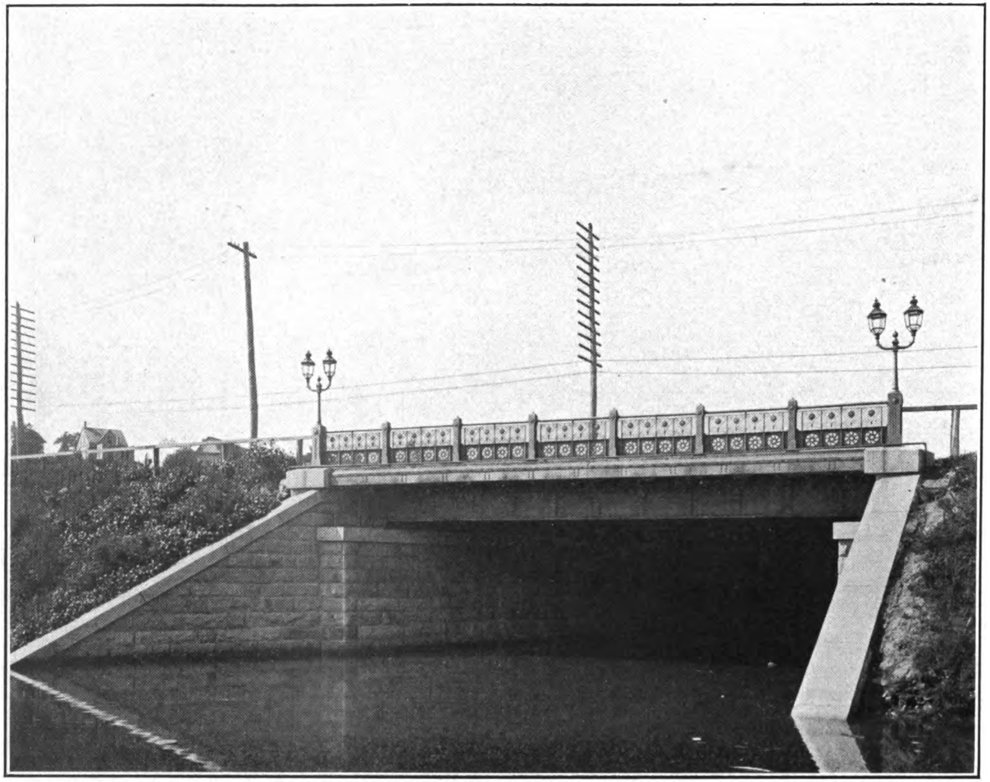
Very little of any other work has been necessary except some repairs to the asphalt pavements.

No. 12—Broadway—

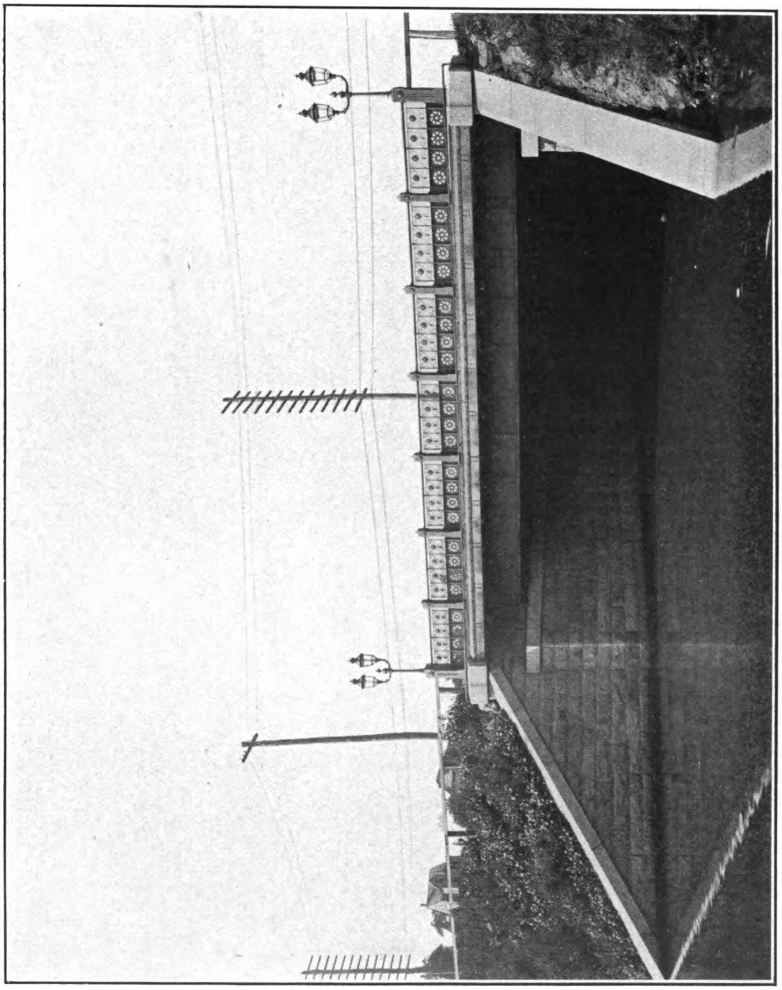
This bridge was painted in September, 1902, and again in December, 1903. It has required no other expenditures.



WASHINGTON BRIDGE, HARLEM RIVER.



BROADWAY BRIDGE, SPUYTEN DUYVIL CREEK.



BROADWAY BRIDGE, SPUYTEN DUYVIL CREEK.

The two old wooden bridges—No. 11, Farmers, and No. 13, Kingsbridge—have been taken care of as a matter of convenience by the organization in The Bronx.

The expenditures for each bridge during three years have been as follows:

	1902.	1903.	1904.
Willis Avenue	$42,775 35	$42,569 08	$52,928 64
Third Avenue	40,687 22	45,176 76	42,233 69
Madison Avenue	16,365 99	16,915 52	17,448 30
Macomb's Dam	37,227 65	32,550 44	43,611 06
New York and Putnam	2,744 66	2,826 55	3,616 95
Washington	3,699 35	6,393 83	4,796 11
Broadway	126 00	106 36	....
Ship Canal	13,185 77	16,049 08	14,079 03
General	23,779 68	19,088 80	25,265 42
Total	$180,591 67	$181,664 90	$203,979 20

An account of travel over the Harlem river bridges was taken in 1898 and also in 1899, but for various reasons was not taken again till June, 1903. The statistics of such travel are useful in showing the relative value to the public of different bridges and are frequently referred to in relation to other questions.

Six bridge tenders from various bridges were selected and assigned to this special duty. They were furnished with tallying machines and note books, were carefully instructed in their duties, and in three shifts of two men each counted travel for 24 hours on each bridge successively. They are entitled to credit for their faithful and intelligent work.

Abstract Account of Travel Over the Harlem River.

For 24 Hours.	Vehicles without Horses.			Horses without Vehicles.			Vehicles.			Foot Passengers.		
	N.	S.	Total.	N.	S.	Total.	N.	S.	Total.	N.	S.	Total.
Ship Canal.												
June 15, 1903..	15	9	24	24	11	35	127	104	231	968	961	1,929
Oct. 31, " ..	104	83	187	16	19	35	246	214	460	1,464	1,422	2,886
" 24, 1904..	73	71	144	29	18	47	341	309	650	1,558	1,434	2,992
Washington.												
June 16, 1903..	63	62	125	11	3	14	158	126	284	652	672	1,324
Oct. 30, " ..	36	30	66	1	9	10	129	122	251	510	566	1,076
" 25, 1904..	59	41	100	5	3	8	160	123	283	590	605	1,196
Putnam.												
June 23, 1903..	..	..	..	..	..	..	....	....	....	912	998	1,910
Oct. 29, " ..	..	..	..	..	..	..	....	....	....	1,150	1,267	2,417
" 26, 1904..	..	..	..	..	..	..	....	....	....	1,237	1,362	2,599
Macombs Dam.												
June 17, 1903..	201	211	412	58	33	91	656	686	1,342	3,592	3,859	7,451
Oct. 24, " ..	189	182	371	40	17	57	625	690	1,315	3,676	3,767	7,443
" 26, 1904..	150	183	333	26	38	64	618	701	1,319	2,126	2,235	4,361
Madison Ave.												
June 18, 1903 { Trolley cars }	993	993	1986	21	10	31	689	627	1,316	2,260	2,374	4,634
{ Other vehicles }	70	55	125									
Oct. 28, 1903..	80	85	165	16	20	36	824	826	1,650	2,047	2,240	4,287
" 27, 1904..	78	85	163	23	20	43	1,150	826	1,976	2,268	2,240	4,508
Third Avenue.												
June 19, 1903 { Trolley cars }	1060	1060	2120	44	65	109	1,775	2,377	4,152	....	....	10,040
{ Other vehicles }	95	135	230									
Oct. 27, 1903..	116	124	240	59	43	102	2,067	2,100	4,167	....	....	11,594
" 28, 1904..	120	109	229	61	59	120	2,101	2,242	4,343	....	....	13,285
Willis Avenue.												
June 20, 1903..	86	101	187	30	28	58	1,200	1,135	2,335	4,412	3,850	8,262
Oct. 26, " ..	141	173	314	21	32	53	1,030	1,073	2,103	2,522	2,680	5,202
" 29, 1904..	315	331	646	52	39	91	1,318	1,376	2,694	5,095	6,631	11,726

Account of Travel Over Ship Canal Bridge During the Twenty-four Hours of October 24, 1904.

Hours.	Vehicles Without Horses.		Horses Without Vehicles.		Vehicles With Horses.		Foot Passengers.	
	North.	South.	North.	South.	North.	South.	North.	South.
12-1 A. M.	..	1	1	..	..	..	28	6
1-2 "	..	..	..	..	..	..	5	..
2-3 "	..	..	..	..	..	..	1	..
3-4 "	..	..	..	..	..	..	..	3
4-5 "	..	..	1	1	1	1	1	..
5-6 "	..	..	..	..	4	5	11	11
6-7 "	3	..	2	1	17	15	48	165
7-8 "	1	1	..	2	14	19	88	152
8-9 "	3	2	1	2	40	23	66	153
9-10 "	1	5	2	1	37	32	65	79
10-11 "	5	3	2	..	40	35	74	70
11-12 M	5	4	5	2	36	27	63	67
12-1 P. M.	7	3	1	2	21	16	102	66
1-2 "	3	1	1	..	27	27	89	85
2-3 "	6	2	2	2	21	28	125	77
3-4 "	18	21	2	1	34	25	134	101
4-5 "	10	17	4	1	29	29	180	120
5-6 "	5	5	3	3	12	9	146	84
6-7 "	..	2	1	..	1	9	136	43
7-8 "	2	1	..	..	3	2	60	29
8-9 "	3	1	..	..	1	1	67	41
9-10 "	1	1	1	..	1	1	31	34
10-11 "	..	..	..	..	1	5	14	29
11-12 MID	..	1	..	..	1	..	24	19
One way	73	71	29	18	341	309	1,558	1,434
Total	144		47		650		2,992	

Account of Travel Over Washington Bridge During the Twenty-four Hours of October 25, 1904.

Hours.	Vehicles Without Horses.		Horses Without Vehicles.		Vehicles With Horses.		Foot Passengers.	
	North.	South.	North.	South.	North.	South.	North.	South.
12–1 A. M.	..	..	..	..	..	..	2	7
1–2 "	..	..	..	..	..	..	1	1
2–3 "	..	..	..	..	..	..	1	..
3–4 "	..	..	..	..	..	..	1	..
4–5 "	..	..	..	..	..	1	4	..
5–6 "	..	..	..	..	3	2	9	..
6–7 "	..	..	..	..	5	2	34	41
7–8 "	..	..	..	..	4	6	25	77
8–9 "	1	2	..	..	8	8	28	28
9–10 "	2	2	..	..	6	8	17	30
10–11 "	6	6	2	..	15	12	29	38
11–12 M	4	3	1	..	17	12	42	40
12–1 P. M.	3	2	..	..	12	7	18	16
1–2 "	..	..	..	..	10	7	49	22
2–3 "	10	5	..	1	14	13	45	28
3–4 "	12	8	..	..	15	12	68	77
4–5 "	11	5	..	2	31	19	65	65
5–6 "	2	4	1	..	14	10	93	49
6–7 "	1	2	1	..	2	2	11	19
7–8 "	2	1	..	..	4	..	11	8
8–9 "	2	..	..	..	..	..	11	25
9–10 "	3	..	..	..	..	..	16	27
10–11 "	..	1	..	..	..	2	9	8
11–12 MID.	..	..	..	..	..	..	1	..
One way	59	41	5	3	160	123	590	606
Total	100		8		283		1,196	

Account of Travel Over Macomb's Dam Bridge During the Twenty-four Hours of October 26, 1904.

Hours.	Vehicles Without Horses.		Horses Without Vehicles.		Vehicles With Horses.		Foot Passengers.		Foot Passengers.	
	North.	South.	N.	S.	North.	South.	North.	South.	North.	South.
12–1 A. M.	..	4	..	1	1	1	20	5	16	8
1–2 "	1	2	..	12	1	1	9	2	10	4
2–3 "	..	..	..	..	..	..	5	4	4	4
3–4 "	..	..	..	..	2	2	5	3	4	4
4–5 "	..	..	..	..	1	2	4	2	6	14
5–6 "	..	..	2	..	5	6	10	15	18	26
6–7 "	3	3	1	..	31	15	37	184	42	116
7–8 "	3	10	2	5	31	48	70	318	46	258
8–9 "	8	5	3	..	69	47	120	207	29	132
9–10 "	10	7	4	1	44	63	70	117	43	53
10–11 "	11	1	4	..	60	50	77	96	20	29
11–12 M	4	9	3	6	45	46	91	101	51	54
12–1 P. M.	5	6	1	..	34	30	62	96	32	39
1–2 "	6	11	..	2	47	54	83	83	105	145
2–3 "	12	12	1	2	68	65	140	144	63	105
3–4 "	12	21	2	..	56	60	147	104	178	89
4–5 "	20	35	..	1	59	97	229	151	63	38
5–6 "	17	24	1	6	21	68	378	260	147	80
6–7 "	3	6	2	..	21	21	180	31	192	53
7–8 "	4	4	..	..	7	9	86	61	62	63
8–9 "	14	4	..	1	8	9	103	81	26	10
9–10 "	10	12	..	..	3	4	98	79	22	16
10–11 "	5	2	..	1	1	1	56	53	21	9
11–12 "	2	5	..	..	3	2	46	38	37	13
One way..	150	183	26	38	618	701	2,126	2,235	1,237	1,362
Total	333		64		1,319		4,361		2,599	

Account of Travel Over Madison Avenue Bridge During the Twenty-four Hours of October 27, 1904.

Hours.	Vehicles Without Horses.		Horses Without Vehicles.		Vehicles With Horses.		Foot Passengers	
	North.	South.	North.	South.	North.	South.	North.	South.
12–1 A. M.	..	..	..	..	..	1	7	10
1–2 "	..	..	2	..	3	..	5	1
2–3 "	..	..	..	..	1	2	3	1
3–4 "	..	1	..	..	8	1	3	5
4–5 "	..	1	..	..	6	6	19	13
5–6 "	1	1	3	..	17	6	38	46
6–7 "	2	10	2	3	62	28	139	371
7–8 "	7	9	5	3	76	26	193	209
8–9 "	8	6	1	2	95	81	148	133
9–10 "	5	1	4	1	100	70	106	56
10–11 "	2	5	..	..	105	91	104	85
11–12 M	3	3	..	..	90	59	81	55
12–1 P. M.	7	2	..	5	56	32	117	93
1–2 "	5	4	..	4	99	67	87	98
2–3 "	8	3	1	1	99	68	129	104
3–4 "	5	5	..	..	102	73	141	157
4–5 "	9	7	2	..	92	104	125	189
5–6 "	7	9	2	..	70	61	403	244
6–7 "	4	7	..	..	31	19	136	99
7–8 "	2	3	..	1	8	14	84	67
8–9 "	2	2	..	..	12	9	69	67
9–10 "	..	2	..	..	7	4	52	63
10–11 "	..	4	1	..	9	4	50	53
11–12 MID	1	..	..	..	2	..	29	21
One way	78	85	23	20	1,150	826	2,268	2,240
Total	163		43		1,976		4,508	

Account of Travel Over Third Avenue Bridge During the Twenty-four Hours of October 28, 1904.

Hours.	Vehicles Without Horses.		Horses Without Vehicles.		Vehicles With Horses		Foot Passengers—North and South.
	North.	South.	North.	South.	North.	South.	
12–1 A. M.	..	1	..	..	5	7	52
1–2 "	..	1	..	..	9	7	51
2–3 "	..	..	..	2	13	16	36
3–4 "	..	..	..	..	25	8	20
4–5 "	..	..	2	..	27	38	44
5–6 "	2	..	3	..	44	58	135
6–7 "	4	6	4	5	135	91	679
7–8 "	9	10	6	1	146	120	904
8–9 "	6	8	2	5	143	216	720
9–10 "	8	4	4	6	143	192	713
10–11 "	7	9	2	4	162	166	689
11–12 M	10	8	3	2	138	164	638
12–1 P. M.	3	3	1	4	139	137	764
1–2 "	5	7	6	2	151	153	825
2–3 "	13	8	14	3	165	180	777
3–4 "	6	6	3	5	145	162	712
4–5 "	14	9	4	5	185	172	694
5–6 "	15	12	3	6	121	169	1,455
6–7 "	9	7	3	1	87	91	848
7–8 "	2	5	..	..	32	39	786
8–9 "	1	1	1	..	29	32	499
9–10 "	5	1	..	8	21	6	424
10–11 "	1	1	..	..	17	8	337
11–12 "	..	2	..	..	19	10	483
One way	120	109	61	59	2,101	2,242	....
Total	229		120		4,343		13,285

Account of Travel Over Willis Avenue Bridge During the Twenty-four Hours of October 29, 1904.

Hours.	Vehicles Without Horses.		Horses Without Vehicles.		Vehicles With Horses.		Foot Passengers.	
	North.	South.	North.	South.	North.	South.	North.	South.
12–1 A. M.	2	..	..	..	1	..	12	14
1–2 "	1	..	..	.	5	6	3	..
2–3 "	..	..	..	..	11	4	..	3
3–4 "	..	1	..	..	32	15	3	2
4–5 "	..	1	..	3	37	36	8	2
5–6 "	3	1	8	..	56	71	186	19
6–7 "	10	6	4	..	60	68	469	101
7–8 "	16	26	6	5	106	77	601	295
8–9 "	18	15	1	..	152	75	173	1,194
9–10 "	24	15	1	2	110	66	186	173
10–11 "	22	27	6	4	94	70	175	264
11–12 M.	29	22	3	2	111	117	289	318
12–1 P. M.	19	25	5	..	55	130	250	490
1–2 "	28	27	2	1	70	64	195	353
2–3 "	25	22	4	5	101	86	325	307
3–4 "	16	18	5	1	79	105	225	337
4–5 "	37	42	3	1	80	109	350	453
5–6 "	20	24	2	13	61	145	395	800
6–7 "	15	20	1	2	44	51	237	294
7–8 "	9	8	..	..	29	31	190	448
8–9 "	10	12	..	..	13	19	222	407
9–10 "	6	4	1	..	7	13	212	170
10–11 "	2	7	..	..	2	12	203	105
11–12 MID.	3	8	..	..	2	6	186	82
Total one way..	315	331	52	39	1,318	1,376	5,095	6,631
Total both ways	646		91		2,694		11,726	

Number of Vessels Passed.

The number of openings and the time required for them on each of the five drawbridges are given below:

1902.

	Average Number of Openings Per Day.	Average Number of Vessels Passed Per Day.	Average Time Per Day Street Travel Stopped, in Minutes.	Average Time Per Opening, in Minutes.
Ship Canal	5.84	8.35	29.71	5.09
Macomb's Dam	3.58	3.63	23.87	6.67
Madison Avenue	5.94	7.89	30.46	5.13
Third Avenue	11.09	26.36	54.87	4.95
Willis Avenue	14.21	22.24	109.94	7.74

1903.

Ship Canal	6.57	8.51	33.39	5.09
Macomb's Dam	3.76	3.67	25.51	6.79
Madison Avenue	5.76	8.02	26.05	4.52
Third Avenue	9.83	22.14	48.74	4.96
Willis Avenue	15.27	22.83	110.17	7.21

1904.

Ship Canal	6.37	7.97	31.99	5.02
Macomb's Dam	3.36	3.24	26.50	7.88
Madison Avenue	5.63	8.33	25.43	4.52
Third Avenue	9.64	21.52	47.81	5.02
Willis Avenue	14.44	23.72	110.53	7.65

The bridges are manned and in operation every day of the year, and these averages are, therefore, based on a year of 365 days.

Respectfully,

MARTIN GAY,
Engineer in Charge Harlem River and Borough of Manhattan Bridges.

Bridges in the Borough of The Bronx.

O. F. Nichols, Esq.,

Chief Engineer, Department of Bridges:

Dear Sir—I have the honor to present the following report on the bridges in the Borough of The Bronx:

No. 1—One Hundred and Thirty-fifth Street Bridge Over Mott Haven Canal—

This bridge was finished on the 23d of July, 1902.

It spans the Mott Haven Canal, a short private waterway opening from the north into the Harlem river, between Third and Park avenues, owned by the Mott Haven Canal Docks Company.

Much coal, lumber and building materials used in the lower part of the borough is handled on the Canal. The new bridge replaced a small timber bobtail draw that had been operated by the Docks Company for many years. It is a deck plate girder structure of the bascule type, with a counter-weighted tail.

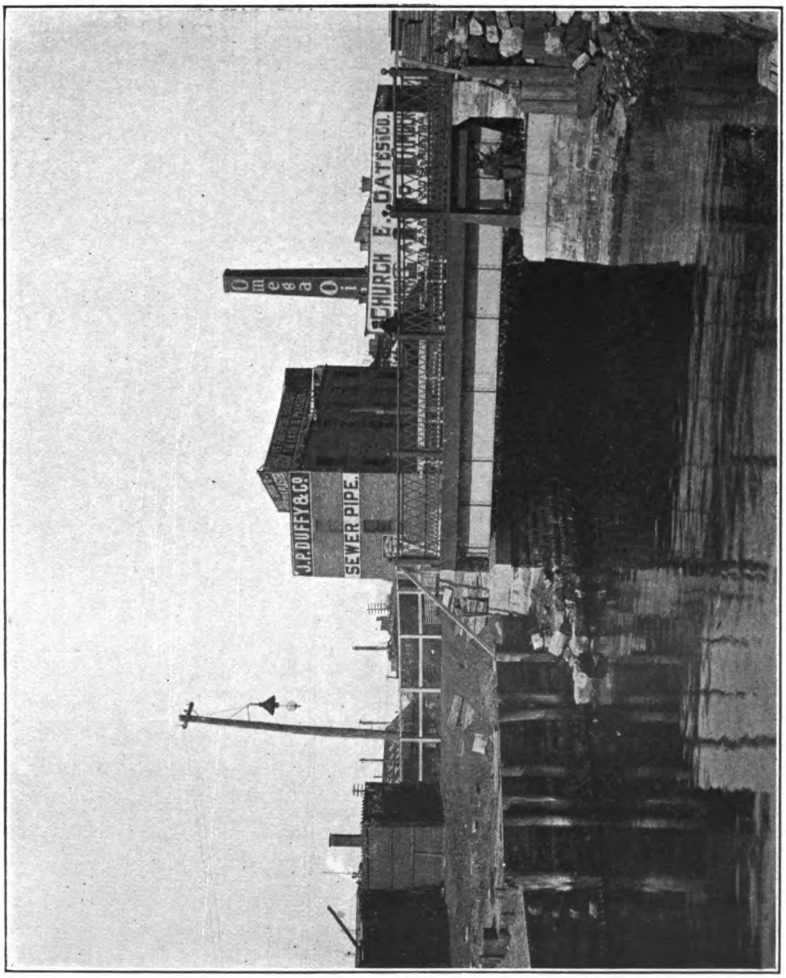
The clear waterway is 26 feet and the width of the bridge is 66 feet, divided into one roadway 42 feet wide and two sidewalks each 12 feet wide.

The roadway is of creosoted yellow pine, with a wearing surface of 2-inch untreated pine. The sidewalks are of yellow pine, spiked to creosoted stringers.

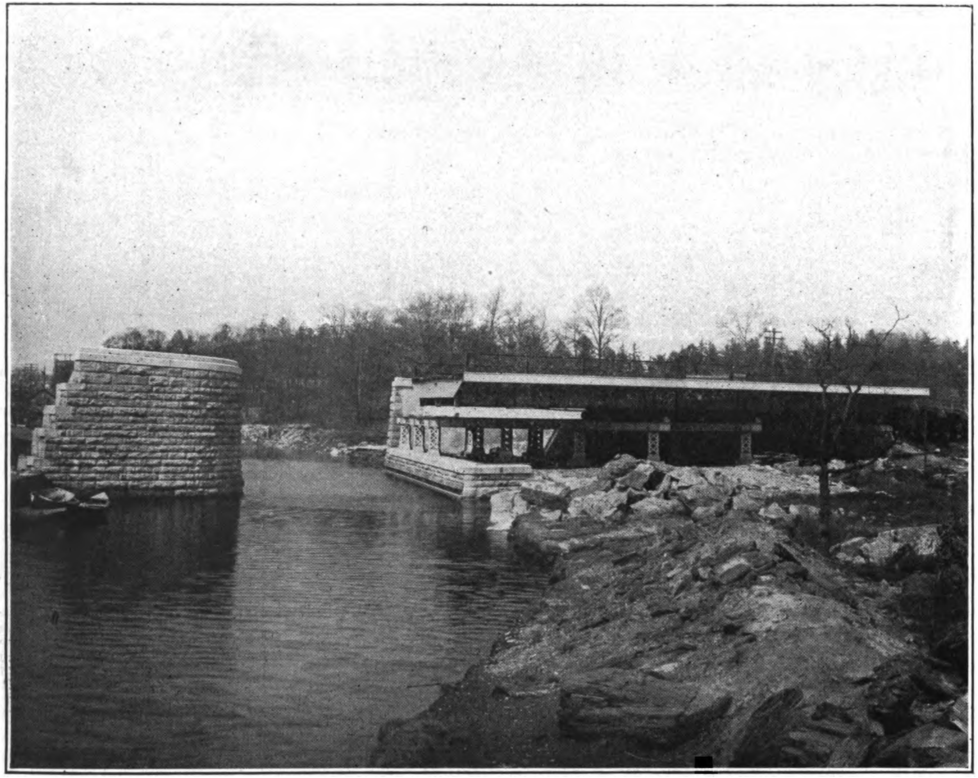
The construction of the bridge was authorized by chapter 523, Laws of 1896. Plans were drawn by the Commissioner of Street Improvements of the Twenty-third and Twenty-fourth Wards in 1897, but a new design was prepared by this Department in 1901, when funds for construction first became available.

The contract for building the bridge was awarded to Augustus Smith, on May 29, 1901, at an estimated cost of $29,360.50. The work was somewhat delayed by difficulties encountered in building the foundations of the tail pit, but was successfully completed after the open caisson method was adopted.

The bridge is operated by an eighteen horse-power direct current motor, the power being obtained from the line of the Union Railway Company and carried in our own conduit from Third avenue. In the past twelve months the bridge was operated 1,456 times for the passage of 2,196 vessels. The openings are made at high water, because the canal tide gates under the bridge



ONE HUNDRED AND THIRTY-FIFTH STREET BRIDGE, BRONX BOROUGH.



WESTCHESTER AVENUE BRIDGE, BRONX BOROUGH (BRIDGE OPEN).

cannot be opened at any other time. Two bridge tenders are in charge and are on duty four hours at every high tide.

No. 2—Westchester Avenue Bridge Over Bronx River—

This bridge is not yet in use, although practically completed. It is a movable single span deck plate girder structure mounted on trucks whose wheels run on elevated tracks set obliquely to the axis of the bridge. It is trapezoidal in plan, having a width of 60 feet and a length increasing from about 60 feet on the up stream side to about 150 feet on the lower side. The Bronx river makes an angle of about 64 degrees with the line of Westchester avenue, and the clear channel for vessels is 40 feet wide. The west abutment is of the ordinary type, with curved wing walls, and supports the end of the draw when the bridge is closed. The east abutment is in two parts; a low section along the river parallel to the west abutment serving as a retaining wall and as protection to the bridge when open, and a long rear abutment at a higher elevation, placed at an angle of about 71 degrees to the river wall, and joining it at its northern end. Two lines of rails are laid on the bridge seat of the rear abutment, and the end trucks under the main girders travel thereon. The west abutment and the East river wall are built of concrete, with limestone ashlar facing, and are protected from collision with vessels by horizontal fenders of oak bolted to the masonry. The east rear abutment is of concrete, with limestone bridge seat and coping. In addition to the track on the bridge seat of the east abutment there are three tracks parallel thereto supported by steel columns that rest on concrete piers. Four trucks under the main girders run on these ways.

The superstructure consists of three main longitudinal plate girders and two oblique end girders with lattice girder floor beams. The flooring is of creosoted yellow pine, protected by a 2-inch wearing surface of untreated pine. The bridge is moved by a cable operated by a 25 horse-power direct current motor. The path is about 50 feet in direction oblique to the axis of the bridge and parallel to the rear abutment, so that the sides of the platform move parallel to themselves, and the bridge in opening recedes from the west bank, and when the end clears the channel it is at the opposite end of the east abutment.

This bridge was authorized by chapter 617, Laws of 1896, and the contract was awarded on August 28, 1901, to John G. Tait,

at an estimated cost of $77,851. It would now be in use if it were accessible, but as its elevation is 24 feet above mean high water, the New York, New Haven and Hartford Railroad, 16 feet below grade, a short distance away, cuts off traffic from the west. The railroad company has completed an overhead crossing on this side and Westchester avenue is being regraded to approach the bridge on the east.

No. 2-T—Westchester Avenue Temporary Bridge Over Bronx River—

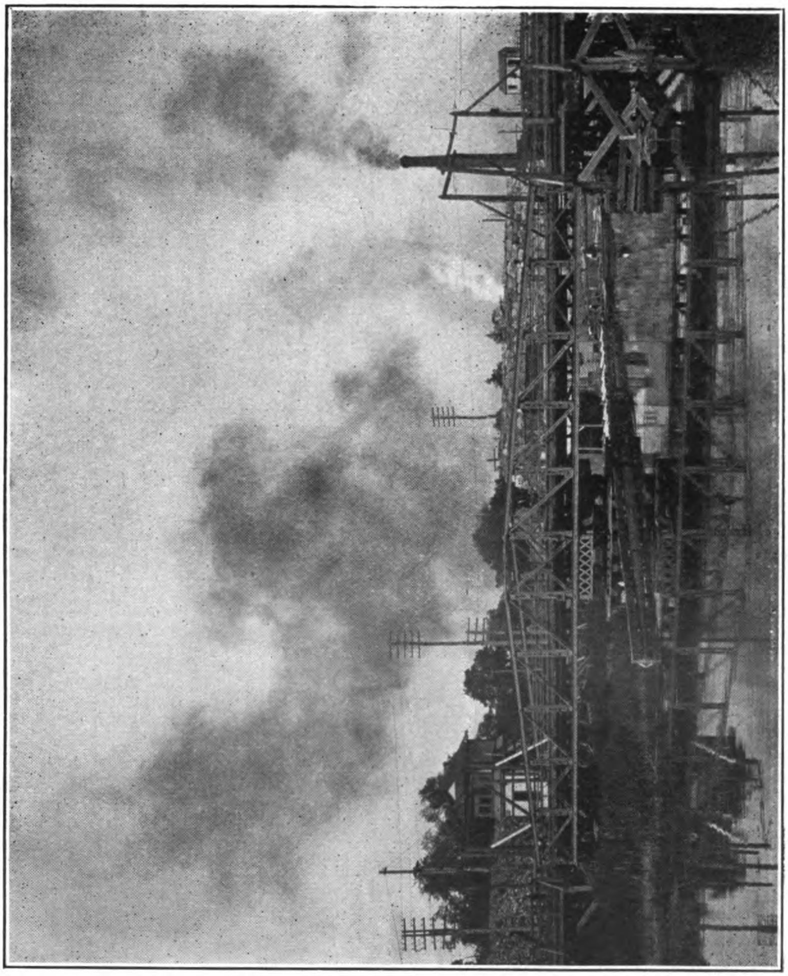
This structure was authorized by chapter 24, Laws of 1897, and has been in use since August, 1899. It consists of an iron pony truss drawspan 114 feet 4 inches long, two timber trestles 109 feet long and 1,147 feet of approaches on embankments and in cuts. The land occupied is leased by the City. The draw span formerly was in use about 100 yards up stream, on the site of the permanent bridge now being built. As soon as the latter structure is opened to travel, it is proposed to remove the temporary bridge to Eastchester and erect it in place of the old draw that now spans Hutchinson river at the Boston Post road.

Constant but small general repairs have been made to the temporary bridge during the past three years. The pivot pier and east abutment have been strengthened, the roadway of the west approach (which has a gradient of over 7 per cent.) macadamized again, and the east approach kept in good order. The wearing surface of 2-inch plank on the draw span and trestles have been completely renewed. The bridge is now operated by a crew of three men, two on regular tours of eight hours, from 5 A. M. to 9 P. M., assisted at high water by one tide man. Vessels ply the stream only at about the time of high water. This bridge will be removed in a few months.

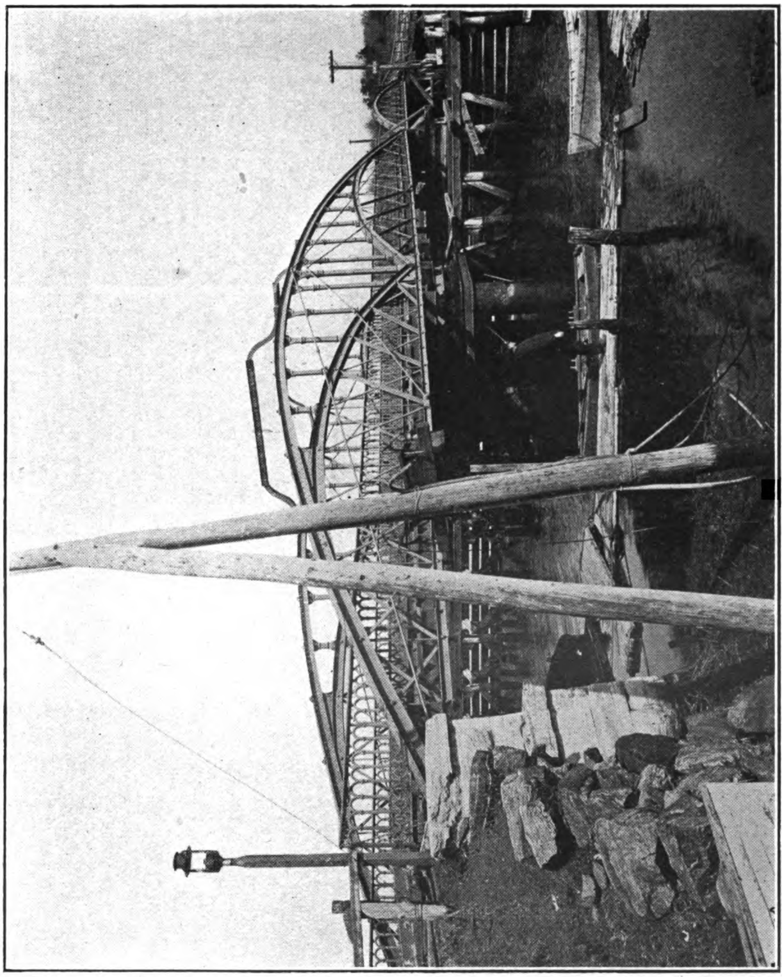
No. 3—Unionport Bridge Over Westchester Creek—

The Unionport Bridge over Westchester creek consists of an iron bowstring draw span 137 feet long, a bowstring fixed span of 51 feet and a timber trestle about 60 feet long. The pivot pier consists of seven plate iron cylinders, the west rest pier is of masonry and the east rest pier is a double bent of square piles.

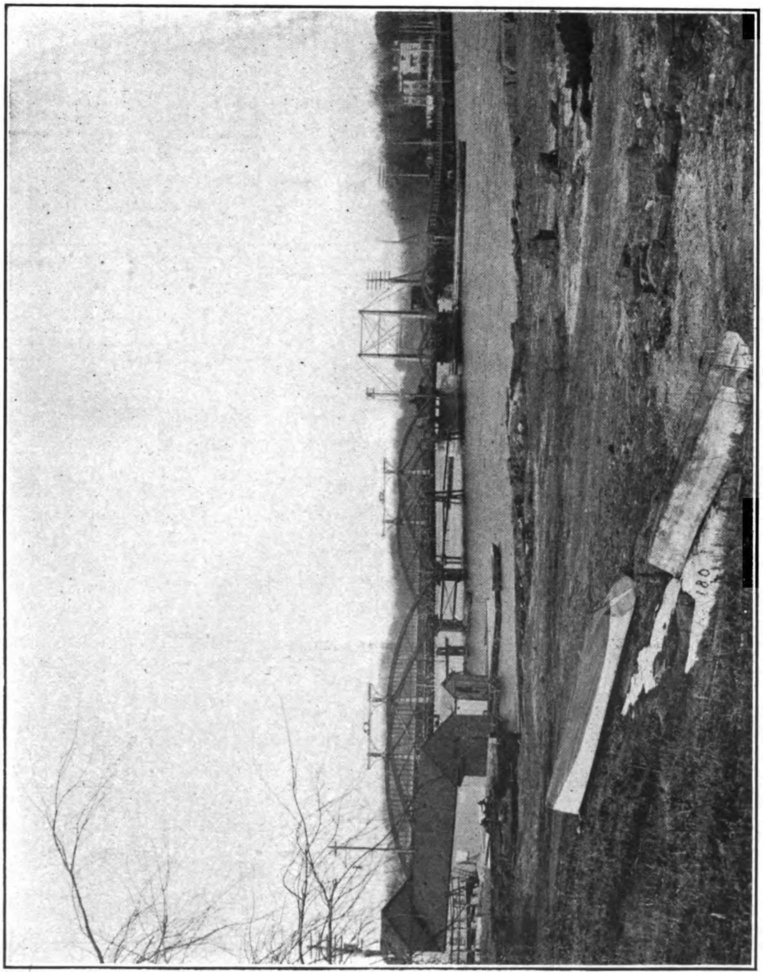
This structure was materially strengthened during 1903. The web system has been reinforced by vertical steel struts and effective sway bracing is now in place. The floor system has been overhauled, the pivot pier is strengthened and the bridge will



TEMPORARY WESTCHESTER BRIDGE, BRONX BOROUGH.



UNIONPORT BRIDGE, BOROUGH OF THE BRONX.



PELHAM BRIDGE, BRONX BOROUGH.

be able to meet the demands of traffic until a new bridge can be built in its place.

The rapid growth of the borough east of the Bronx river has resulted in the opening of new main arteries of travel. One of the most important, the extension of Tremont avenue, crosses Westchester creek at the site of the present Unionport Bridge, and the old narrow structure will be totally inadequate for the traffic that will be brought by the new thoroughfare. Studies are now being made for a modern bridge at this site and the work preliminary to reconstruction will be commenced at once.

A temporary bridge will be required and the existing bridge can be moved to an adjacent street and used for that purpose. I shall soon submit surveys and a plan for the preliminary work.

No. 4—Pelham Bridge Over Eastchester Bay—

This structure was transferred from the Department of Parks to the Department of Bridges in December, 1902. The design prepared by the Department of Parks having been rejected by the Art Commission, a new plan was prepared in which the architectural features received much attention. The present design embraces six reinforced concrete arches of 105 feet span, and a two-leaf rolling lift bridge for the passage of vessels. The width of the bridge will be 52 feet, of which 34 feet is a paved roadway. The two channel piers are of greater dimensions than the others, and will be surmounted by four ornamental towers, about 60 feet high, within whose bases will be located shelter houses for bridgetenders and public comfort stations. The new bridges will be built a short distance westerly from the present structure.

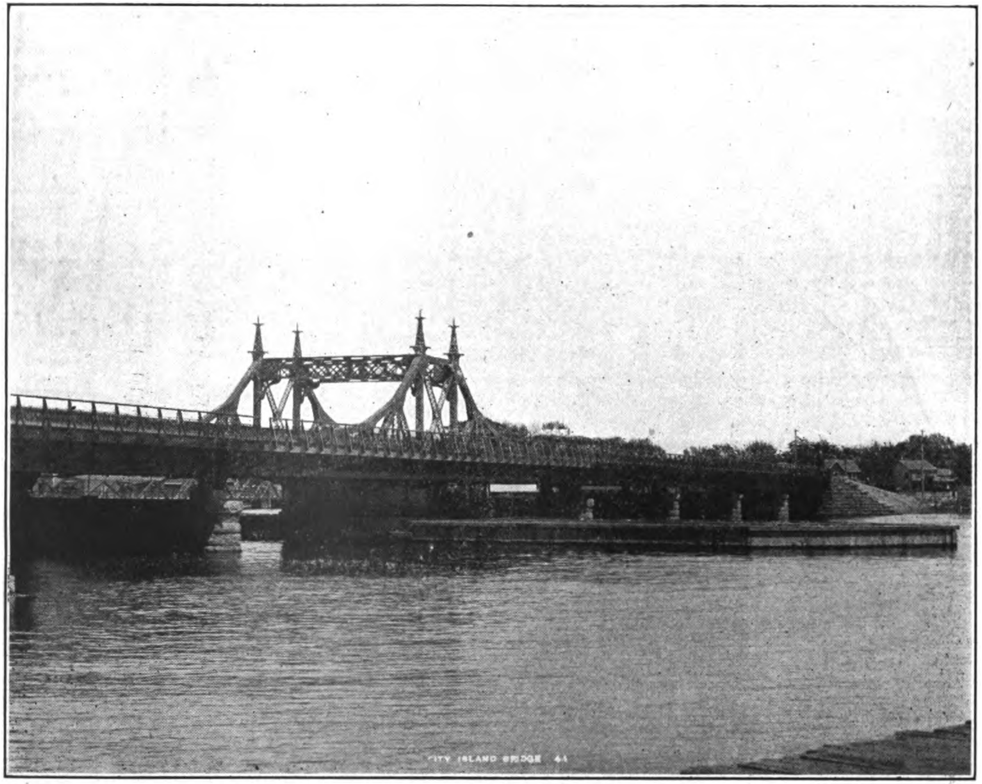
A contract for the foundations and superstructure was prepared during the summer of 1903, but the work was not let, as the two bids received were deemed excessive. A separate plan for the foundations, piers and abutments was then drawn, and bids were received for this portion of the work on November 12, 1903. The tenders were more favorable to the City, and the contract was let to William J. Lawler, of Charlestown, Mass., at the estimated cost of $208,905.

On account of severe weather work on this contract was not started until April, 1904. The foundations of one abutment, two intermediate piers and of one draw span pier are now practically finished; the other four foundations and all the masonry above low water cannot be built until next spring. The contract

Bids for Pelham Bridge Foundations, November 12, 1903.

	Item.	Quantities.	Wm. J. Lawlor.		Jos. Gallo.		Bernard Rolf.		United Engineering and Contracting Company.		J. J. Hopper.	
			Unit Price.	Amount.	Unit Price.	Amount.	Unit Price.	Amount.	Unit Price.	Amount.	Unit Price.	Amount.
1	Excavation....................	13,000 cubic yards.	$0 95	$12,350 00	$2 00	$26,000 00	$2 00	$26,000 00	$2 50	$32,500 00	$0 48	$6,240 00
2	Rock excavation	50 "	3 00	150 00	6 00	300 00	10 00	500 00	8 00	400 00	12 00	600 00
3	Piles.........................	20,000 lineal feet..	20	4,000 00	35	7,000 00	70	14,000 00	80	16,000 00	75	15,000 00
4	No. 1 concrete.................	14,500 cubic yards.	7 25	105,125 00	11 00	159,500 00	12 00	174,000 00	13 25	192,125 00	16 20	234,900 00
5	No. 2 concrete.................	6,500 "	7 00	45,500 00	8 00	52,000 00	6 50	42,250 00	8 00	52,000 00	7 20	46,800 00
6	Masonry.......................	500 "	20 00	10,000 00	42 50	21,250 00	34 00	17,000 00	40 00	20,000 00	21 60	10,800 00
7	Steel bars.....................	236,000 pounds.....	0 05½	12,980 00	06	14,160 00	08	18,880 00	06	14,160 00	06	14,160 00
8	Rip-rap	1,200 cubic yards.	2 25	2,700 00	1 50	1,800 00	75	900 00	1 00	1,200 00	1 20	1,440 00
9	Sheet piling...................	250,000 feet, B. M..	50 00	12,500 00	19 00	4,750 00	40 00	10,000 00	30 00	7,500 00	42 00	10,500 00
10	Yellow pine fenders.	12,000 " " ..	50 00	600 00	60 00	720 00	50 00	600 00	50 00	600 00	96 00	1,152 00
11	Plans.......	....	....	3,000 00	....	3,000 00	....	3,000 00	....	3,000 00	...	3,000 00
	Total..................................		....	$208,905 00	....	$290,480 00	....	$307,130 00	....	$339,485 00	...	$344,592 00

Contract awarded to Wm. J. Lawlor, December 3, 1903.



CITY ISLAND BRIDGE, BRONX BOROUGH.

for the concrete steel arches and the steel draw span will be ready for letting at that time.

This work was much delayed by severe weather and by the difficulty in excavating at the pier sites, where hard gravel and large boulders were encountered instead of the sand and gravel indicated by the test borings. The work covered by the present contract is not yet half done.

Studies are now being made for a modified plan that will preserve the attractive features of the original plan and at the same time add to the stability of the structure.

No. 4T—Old Pelham Bridge Over Eastchester Bay in Pelham Bay Park—

The old bridge consists of two iron Moseley arch trusses of about 125 feet span, and one draw span about 140 feet long, with causeway approaches about 900 feet long. It is of antiquated type, and was in need of repair when the Department of Bridges took charge. The two fixed spans have been reinforced by pile bents under the trusses, the drum and turning gear of the draw have been strengthened and repaired, the roadway on the causeway approaches have been macadamized and about 800 feet of new sidewalk have been laid on the approaches. The bridge will be adequate for traffic until the new arch bridge is finished, and meantime serves the purpose of a temporary bridge.

No. 5—City Island Bridge—

This new bridge connecting Pelham Bay Park with City Island was opened to the public on July 4, 1901. It was authorized by chapter 638, Laws of 1894, and chapter 507, Laws of 1896. It consists of five plate girder spans of 80 feet, and one draw span of 168 feet, and it has a width of 50 feet. It is paved with asphalt carried by a buckle plate floor. The approaches are about 1,100 feet long, with sidewalks and a Telford roadway. This structure has needed few repairs, and has been maintained at small cost. During the coming year, however, it will need painting, and the roadway of the approaches must be resurfaced.

Old City Island Bridge—

The deck of the old City Island Bridge was removed in 1901, but the piers continued to obstruct navigation until 1902, when a contract was let for removing the old cribs. This work was

performed by the Morris & Cummings Dredging Co. for $5,813.04.

No. 6—Eastchester Bridge Over Hutchinson River—

The drawbridge carrying the Boston Post road across the Hutchinson river is an old iron pony structure, 105 feet long. It is within a few hundred yards of the northern limit of the City, and, while it is on one of the oldest highways in the State, the traffic across it is rather light. Only a few general repairs have been necessary. The structure is however, old and nearly worn out, and as the improvement of the old thoroughfare will increase the travel I recommend that the present span be replaced with a better bridge.

No. 11—Farmer's Bridge Over Spuyten Duyvil Creek—

This crossing, formerly Dykeman's Bridge, was built during the eighteenth century, when Jacob Dykeman and Johannes Vermilyea erected it in opposition to the toll bridge maintained by Philipse a short distance north.

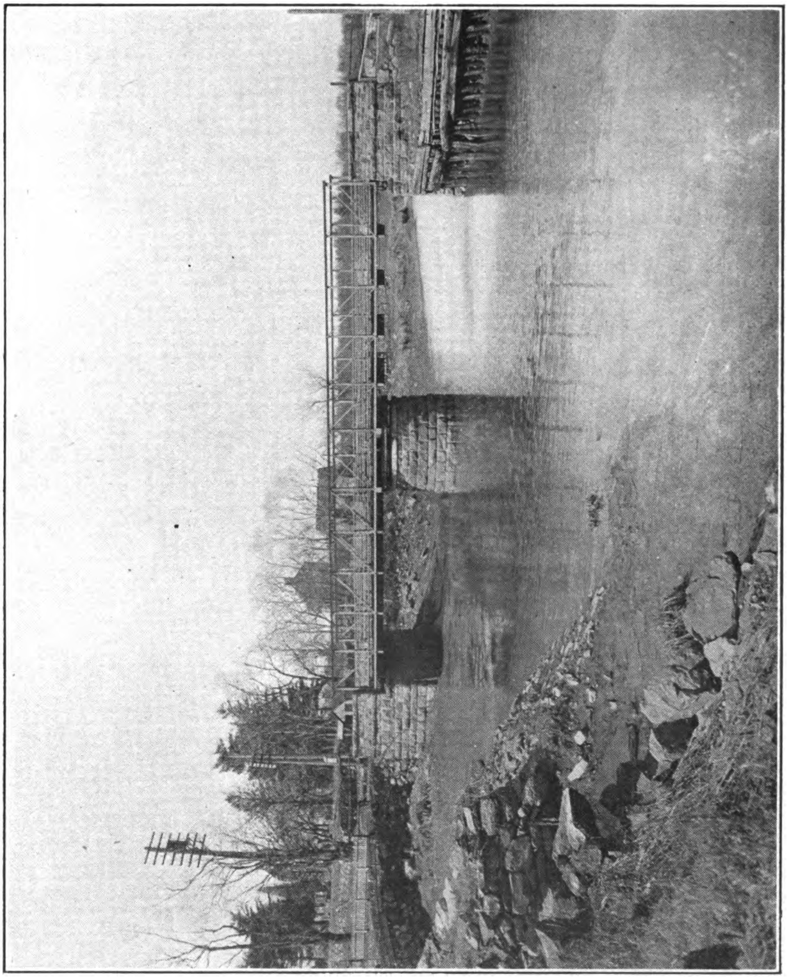
This structure was in use only a short time during 1902 and 1903, as no traffic could pass the trenches of the Broadway trunk sewer which blocked the east approach. When that work was completed the old bridge was torn down and rebuilt.

No. 13—King's Bridge Over Spuyten Duyvil Creek—

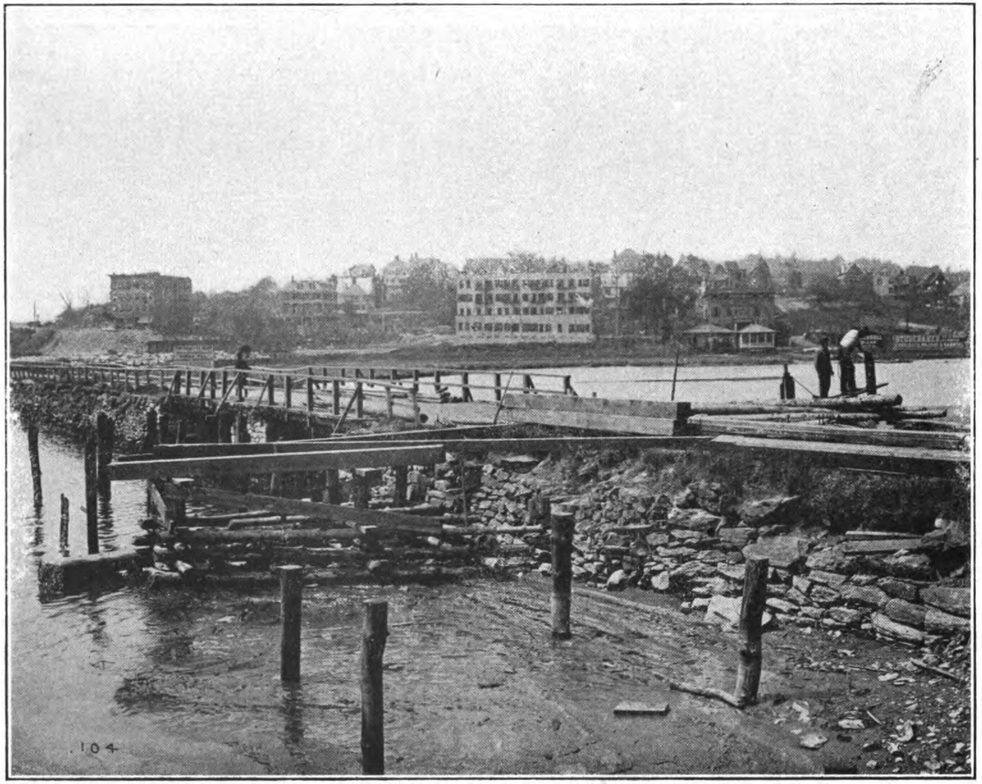
According to old records of the city, this crossing was built in 1693 by Frederick Philipse, lord of the manor of Philipsburg, who maintained it under royal charter as a toll bridge for the accommodation of travel to Albany and Boston. It is probably the oldest existing bridge in The City of New York. The superstructure has recently been rebuilt.

King's Bridge and Farmer's Bridge have much historic interest. They are frequently mentioned in the records of the city for the seventeenth and eighteenth centuries and in accounts of travelers of those times. They were the sites of several engagements during the Revolution, as no other crossing from Manhattan Island then existed.

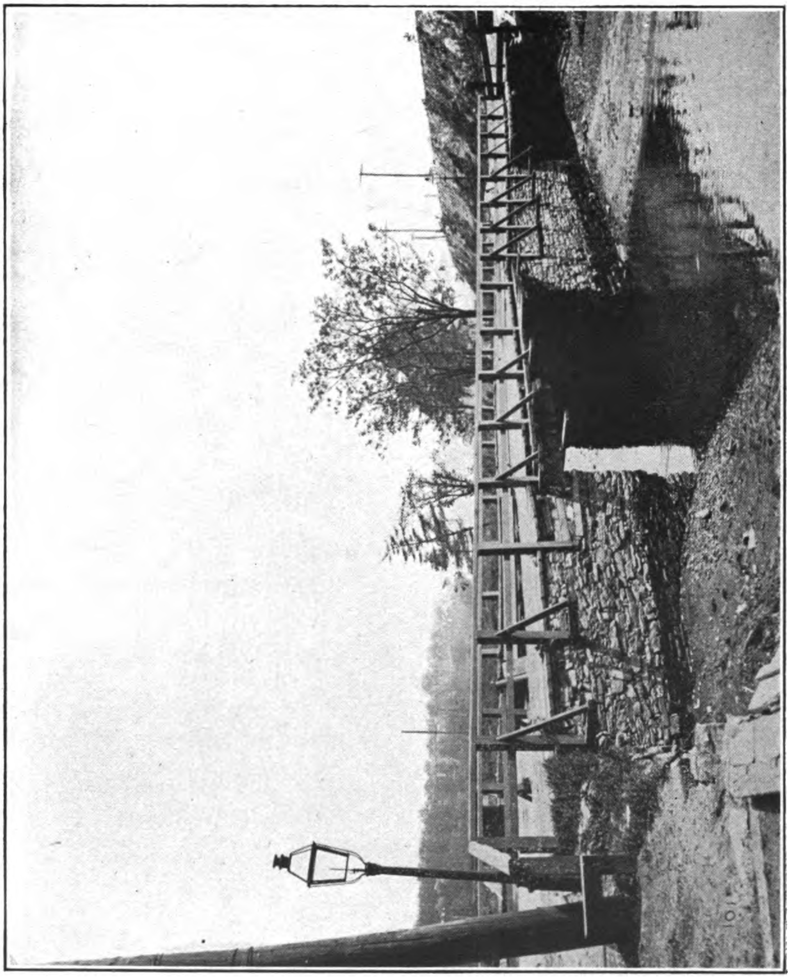
Of the nine bridges in service in The Bronx, three are manned only at high water, two are without bridge tenders and two have carried only occasional vehicles because the approaching highways have been temporarily closed. No record of street



EASTCHESTER BRIDGE, BOROUGH OF THE BRONX.



FARMER'S BRIDGE, SPUYTEN DUYVIL CREEK.



KINGSBRIDGE, SPUYTEN DUYVIL CREEK.

travel has been kept, but the following is a statement of the number of bridge openings and of vessels passing through the spans during the years named:

Name of Bridge.	1902.		1903.		1904.	
	Openings.	Vessels Passing.	Openings.	Vessels Passing.	Openings.	Vessels Passing.
135th Street.............	*412	*829	1,456	2,140	1,846	2,196
Westchester Avenue......	1,126	2,680	1,031	2,618	822	1,907
Unionport..............	1.138	1,722	1,549	2.607	1,588	2,941
Pelham..................	*49	*92	653	1,148	806	1,385
City Island.............	517	349	677	634	644	553
Eastchester..............	494	796	467	875	583	966
Totals...........	3.736	6,468	5,833	10,022	6,289	9,948

* The bridge at One Hundred and Thirty-fifth street was not opened until August, 1902, and Pelham Bridge was not transferred to this Department by the Department of Parks until December, 1902.

The superstructures of Kings Bridge and of Farmers Bridge, over Spuyten Duyvil Creek, have been entirely rebuilt during 1904. Most of the other structures have been replanked and are now in fair condition. The principal requirements during the coming year will be the relaying of the asphalt pavement on the City Island Bridge and the strengthening of the old Pelham Bridge.

Respectfully submitted,

J. G. THEBAN,

Engineer in Charge, Borough of The Bronx.

BRIDGES IN THE BOROUGHS OF BROOKLYN AND RICHMOND.

DECEMBER 31, 1904.

O. F. NICHOLS, Esq.,
Chief Engineer, Department of Bridges:

DEAR SIR—I have the honor to hand you herewith a report on the bridges in the Boroughs of Brooklyn and Richmond for the year ending December 31, 1904.

BOROUGH OF BROOKLYN.

No. 1—Hamilton Avenue Bridge Over Gowanus Canal—

A new bridge at this point was authorized on November 18, 1903, and the change of grade of the approaches was authorized on November 27, 1903. Bids were opened for the bridge on December 30, 1903, and on the following day the contract was awarded to the lowest bidder, the R. H. Hood Co.

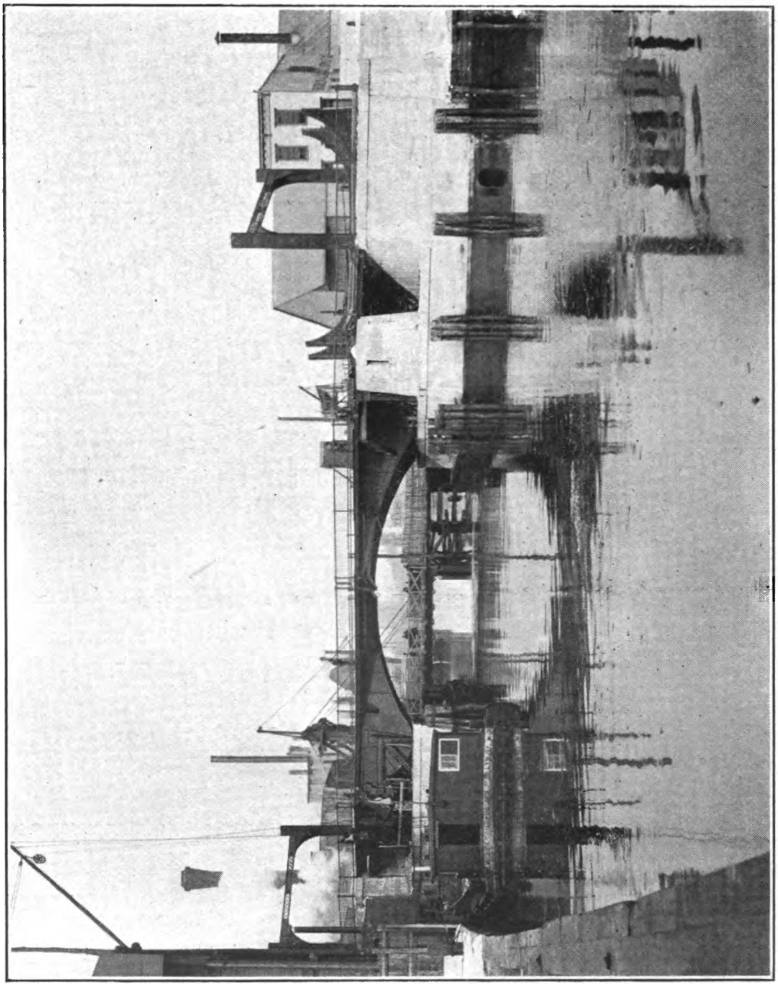
The contract was certified on February 1, 1904, and work on the temporary bridge, at the foot of Thirteenth street, to provide a crossing for street travel during the construction of the new bridge, was begun on February 9 and finished on April 5, 1904, when the work of removing the old bridge was commenced.

The work has been vigorously prosecuted and the new bridge should be ready for the public on the contract time, which has been changed from May 1, 1905, to March 1, 1905.

Fewer openings will be required with the new bridge, owing to the grade being raised 10 feet, giving 18 feet headroom for vessels at high water, which will allow about 80 per cent. of the vessels to pass under the bridge without requiring it to be opened.

The tonnage of the vessels coming into the Gowanus Canal and passing Hamilton avenue amounts to about 2,000,000 tons per year, a traffic which requires strict regulation to prevent congestion on a canal only 100 feet wide.

The grading and paving of the bridge approaches to the higher level will be completed by the time the bridge is ready, with the exception of one block of Smith street, from Hamilton avenue to Bush street, which is being used by the travel over the temporary bridge. After the new bridge is opened this block will be graded and paved. The pavement over the streets raised to the higher grade has been placed on a sand foundation to allow for the settlements in the fill which will surely occur. After this temporary pavement has received a year's wear and the fill is thoroughly con-



HAMILTON AVENUE BRIDGE, BROOKLYN BOROUGH.

solidated, the whole area should be repaved with new granite block on a concrete foundation.

The new bridge crosses the canal at an angle of 56 degrees, and is a deck bridge of two leaves, providing a 50-foot channel, a 35-foot roadway containing two electric car tracks, and two 6-foot sidewalks.

The main feature is the treatment of the skew by which the span is reduced to 60 feet. The two leaves are alike, and meet over the centre line of the channel, and the main girders of each leaf are at right angles to the channel.

Each leaf is made up of two plate girder rockers 36 feet apart and offset from the corresponding rocker girder on the opposite leaf 20 feet to take the skew. The overhangs are supported by brackets from the rocker girders. Each rocker girder rests on a track plate secured to built up girders embedded in the masonry and resting on grillages at the points of forward and rear bearings. Teeth on the track plates engaging slots in the segmental portions of the rocker secure the leaf against displacement. In the rear of the point of bearing a circular segment of 8 feet radius provides for 62 degrees rolling motion. The centre of this segment is made the centre of gravity of the rolling load by distributing cast-iron counterweights in the rear of the rear floor beam counterbalancing the unsymmetrical arms.

Under live loads the levers act as cantilevers. Live loads in rear of the bearing line are transmitted through tail locks in rear of each rocker to the approach floor beam.

The approach spans are similar for each leaf, and overhang the approach floor beam 7 feet, to provide clearance for the tail end during the rolling motion of the moving span. The deck is of two layers of 3-inch yellow pine, and the lower deck is creosoted. All sidewalk joists are creosoted yellow pine and bolted to angles on the brackets. Each leaf is electrically operated by a 25 horse-power motor, with solenoid brake attachment, suspended from the floor joists in the tail of the leaf and moving with the bridge. The main pinion shafts are brought through the rocker girders at the centre of the rolling segment, their pinions engaging fixed horizontal racks supported on girders outside of the rockers. Control of the operation may be had from each side, or from one side only, by means of a submarine connection to the motor on the opposite leaf. Contacts placed on the rack girders are employed to stop the bridge at the full open

and closed positions. The first notch of the controller releases the solenoid brakes, and on the second notch the current goes to the motors.

Each rocker girder was shop riveted complete and erected in a vertical position. One was first erected and guyed in place, then the three floor beams were bolted to it and the free ends blocked up in position, each a few inches higher than its final position. The other rocker girder was then swung into position, successively engaged with the floor beams and bolted up; the partially assembled leaf was then lowered over the teeth of the track plates. The end floor beam, being web connected to the ends of the rocker girders, was then readily swung into place. The brackets were then erected, followed by the laterals and stringers. All machinery was erected and temporary electrical installation made before the leaves were lowered.

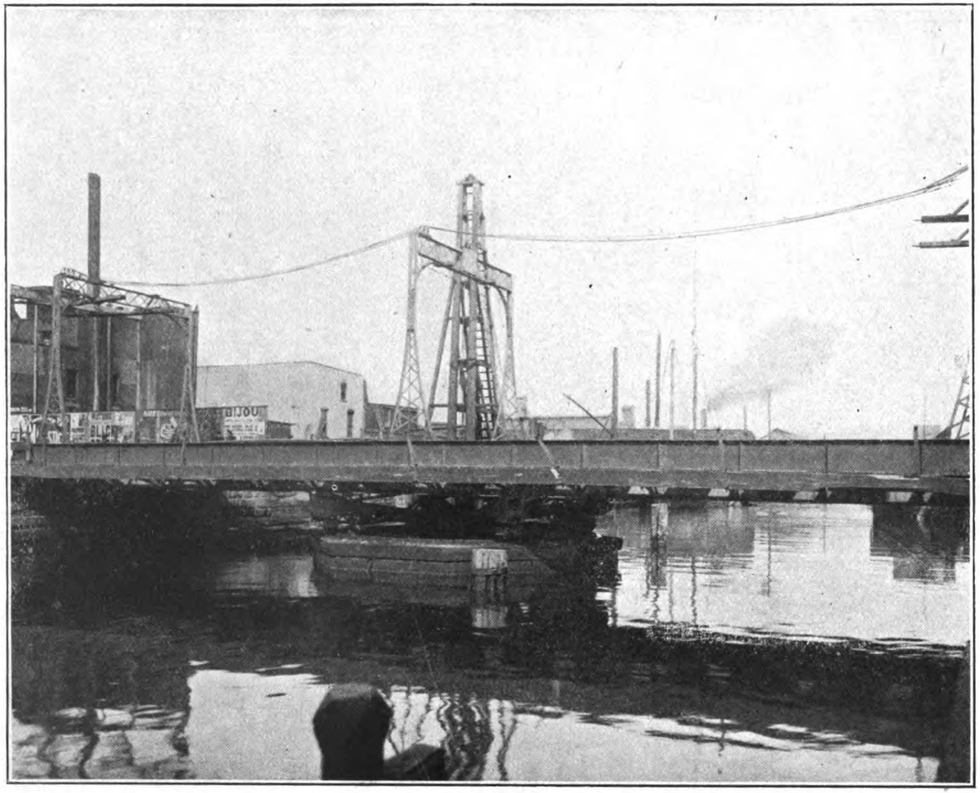
All masonry is of concrete, with 18-inch limestone copings. The rest piers have outside dimensions of 53 by 19 feet, and are founded on piles at 18.5 feet below mean high water.

The abutments, low-faced walls forming the tail pits and the foundations of the operators' houses, are built on timber platforms supported on piles cut off at mean low water. The steel superstructure was fabricated at the Pennsylvania Bridge Company's shops at Beaver Falls, Pa., and erected by the general contractors.

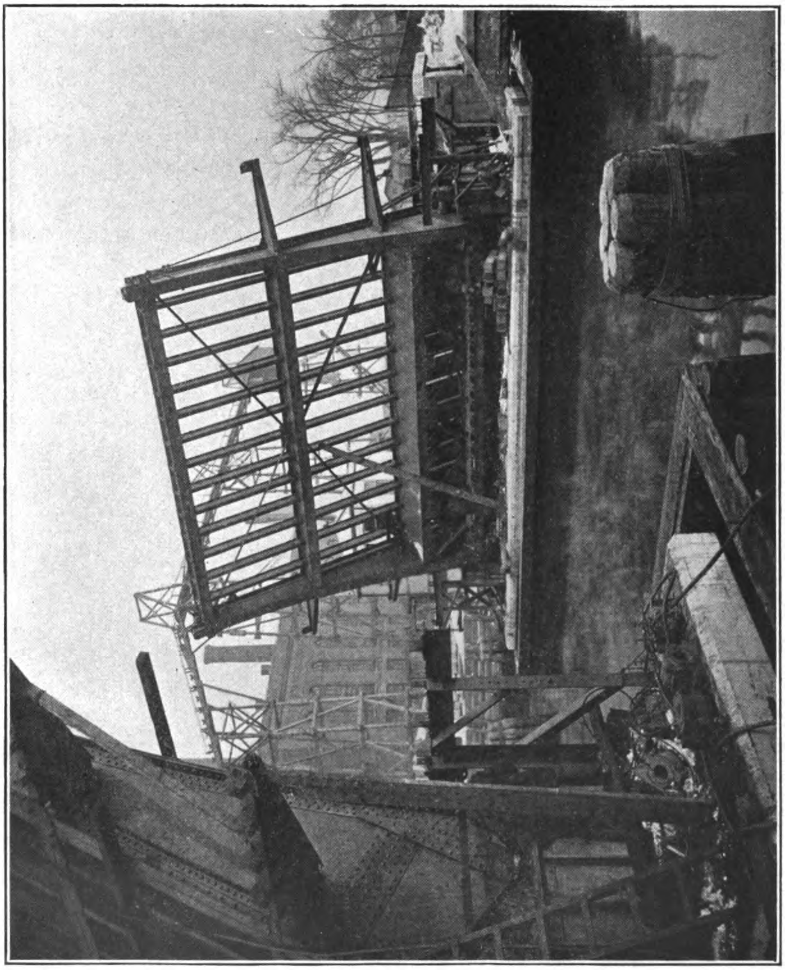
The principal quantities are: Steel, 260 tons; cast-iron counterweights, 115 tons, and machinery, 18 tons. Each moving leaf weighs 175 tons, the electrical equipment cost $3,000 and the total estimated cost is $175,000, which includes raising the grade of Hamilton avenue 10 feet at the bridge.

No. 2—Ninth Street Bridge Over Gowanus Canal—

The waterways of the old bridge are narrow—31½ feet east and 32 feet 9 inches west channel—and property owners on the canal petitioned the Department to build a new bridge with a centre channel 50 feet wide. In response to this petition authority was sought to build a new bridge, and the Board of Estimate approved a bond issue for this purpose on May 31, 1901, but the measure was then lost in the Board of Aldermen. It was, however, passed again in the Board of Estimate on September 23, 1903, and in the Board of Aldermen on November 11, 1903, and signed by the Mayor on November 18, 1903.



NINTH STREET BRIDGE, BEING DISMANTLED, BROOKLYN BOROUGH.



THIRD STREET BRIDGE, BROOKLYN BOROUGH.

A notable feature in the new bridge plans is that this bridge and the new Union and Third Street bridges will all be built from the same shop plans and will be exactly alike as to the superstructures, local differences being adjusted in the masonry. The superstructures of the three bridges are described under Union Street Bridge. Bids for these three new bridges were opened December 30, 1903, and the contract was awarded to the R. H. Hood Company, the lowest bidder.

Owing to the inability to obtain a right of way, no temporary bridge will be built while the new bridge is being constructed, but the old bridge will be kept in use until the new Hamilton Avenue and Union Street bridges are completed, which will probably be about March 1, 1905. When the field work is commenced, it should proceed rapidly, as all the steel and machinery are delivered, and the contractor has had the experience of building two similar bridges. The time for the completion of the new bridge has been reduced from one year to 150 working days.

The new bridge is to be built on the same grade as the old one, the local conditions being such that a raise in the grade similar to that at the Hamilton Avenue Bridge, despite its desirability, is almost prohibitive. While the new bridge is under construction the cars of the Brooklyn and Coney Island Railroad will pass over Union Street Bridge.

Authority has been requested to widen the roadway of Ninth street, from Canal to Smith street, from 30 feet to 35 feet, by moving the curb line back into the present sidewalks 2½ feet, making the sidewalks 12½ feet, instead of 15 feet, as at present.

The new bridge roadway will be 35 feet wide, which is the width of Ninth street, from the canal east to Third avenue.

No. 3—Third Street Bridge, on Gowanus Canal—

The old bridge was closed to the public on March 15, 1904, when the construction of the new bridge was commenced.

The old structure was a pipe truss, drum-bearing swing bridge, with one 17-foot roadway, and was operated by hand.

The new bridge will be at a grade 5 feet higher than the old bridge, and this higher grade is obtained by raised approaches, occupying the central portion of the street and leaving side roads for the convenience of property-owners near the bridge. The dimensions of the new bridge are the same as the other new Gowanus bridges, with the exception of the roadway, which is

30 feet wide, there being no car tracks on the bridge. No temporary bridge is provided, as the Carroll Street Bridge is but three blocks away.

Owing to delays for which the contractor was not responsible, the time for completion was extended from January 1, 1905, to March 28, 1905, by which time the new bridge should be ready.

A more detailed description of the new bridge is given under Union Street Bridge, as the two are so nearly alike.

No. 4—Carroll Street Bridge Over Gowanus Canal—

This is a plate girder retractile drawbridge, and is operated by steam. It was built in 1889 by the Trenton Iron Works, on pile and timber foundations, and is in good condition. It is trapezoidal in shape, 104 feet long on the centre line, with a 17-foot roadway and 4-foot sidewalks. The channel for vessels is 38 feet wide. The roadway was replanked with 3-inch yellow pine in July, 1902, and March, 1904.

No. 5—Union Street Bridge Over Gowanus Canal—

The old structure was used by the public for the last time on March 14, 1904, when its removal was commenced, to allow the construction of the new bascule bridge to proceed, the contract for which was let on December 30, 1903.

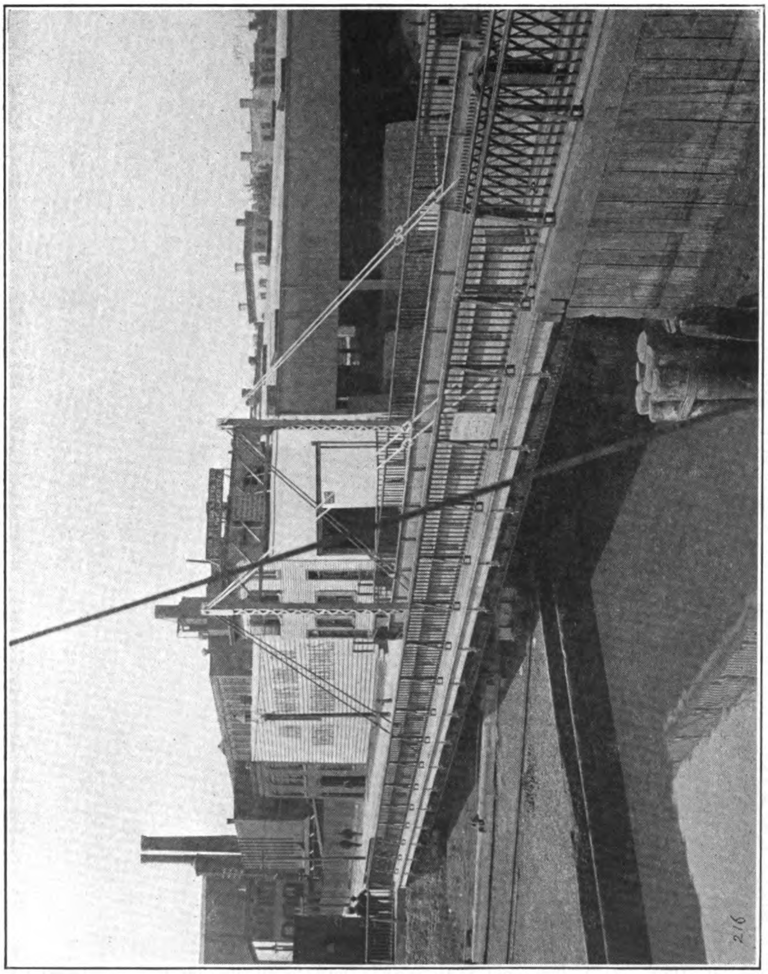
The old bridge was a pipe truss swing bridge, like the old Third Street Bridge, with a roadway only 17 feet wide. A greater time than was anticipated was consumed in removing the old pier, whose solidity bore witness to the faithful work of its builders.

The new bridge will be built on the same grade as the old one, and allowance is made for car tracks, which will be used by the Smith street line while the new Ninth Street Bridge is being built, and also by the Union Street line of the Brooklyn Rapid Transit Company.

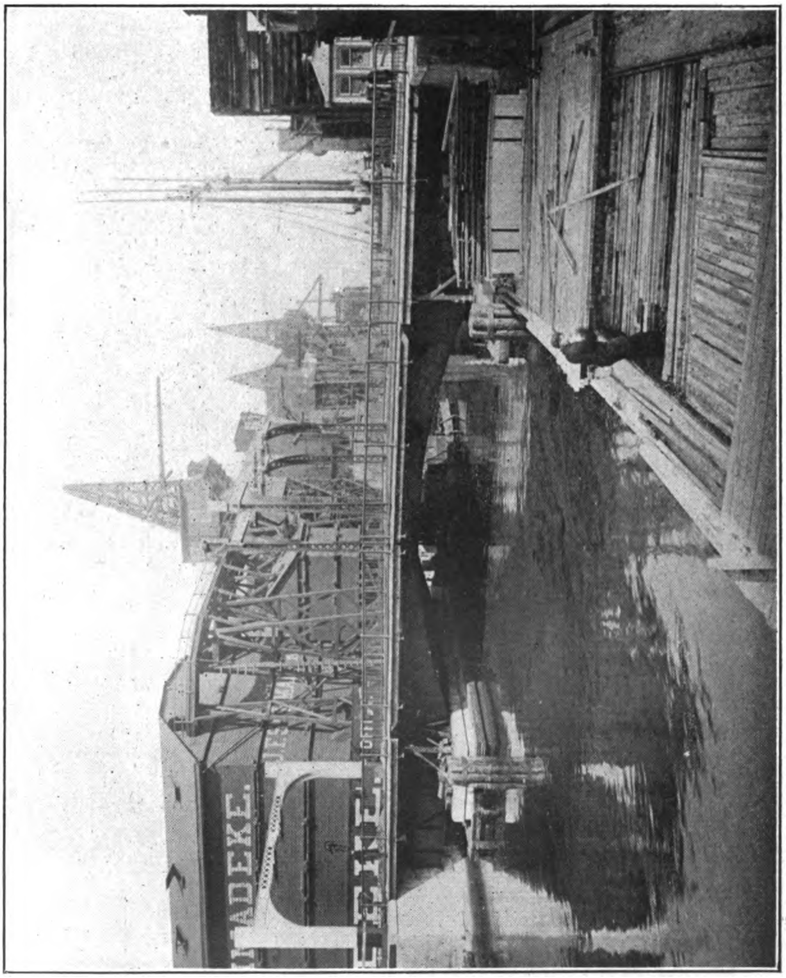
The work on the new bridge is well advanced and undoubtedly will be completed within the contract time.

As at Ninth street, it is proposed to widen the roadway of Union street, from the canal to Bond street, from 30 feet to 35 feet.

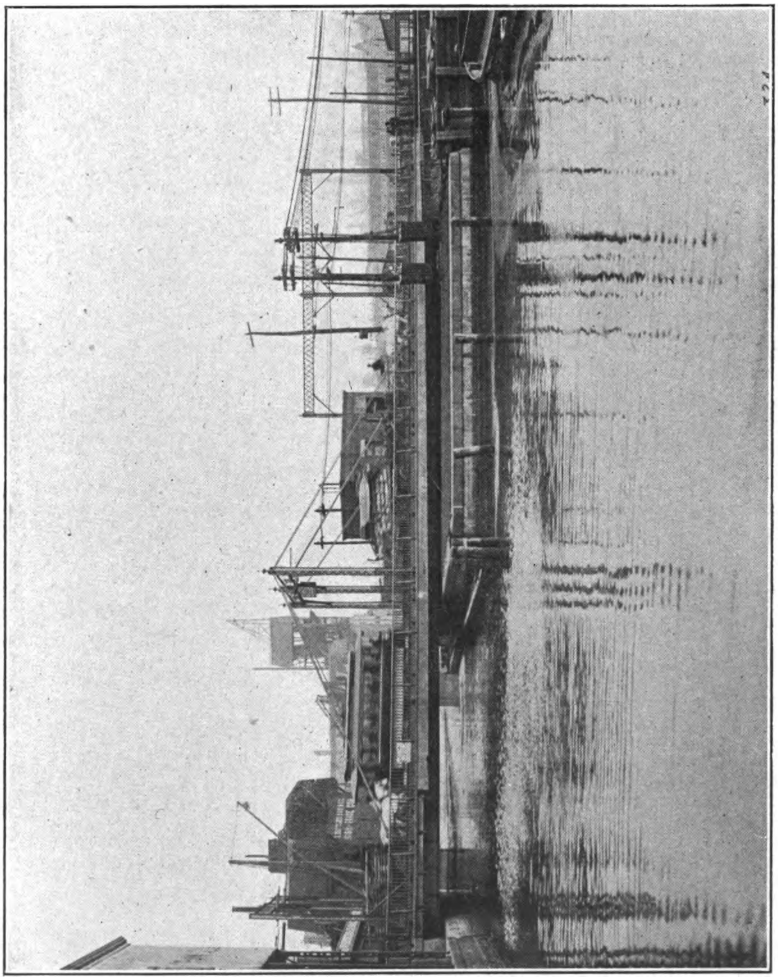
The new bridges at Ninth and Third and Union streets are of the two-leaf Scherzer deck type. These three bridges were placed in one contract and are alike, the same shop plans being used for all three, local differences being adjusted on the masonry. A



CARROLL STREET BRIDGE, BROOKLYN BOROUGH.



UNION STREET BRIDGE, BROOKLYN BOROUGH.



WASHINGTON AVENUE BRIDGE, BROOKLYN BOROUGH.

50-foot clear channel, with 9 feet headroom, one 35-foot roadway and two 6-foot sidewalks are provided. Each leaf is supported on two rocker girders, 33 feet 7 inches centres, the extreme width of superstructure being 48 feet 4 inches.

The sidewalks are carried on brackets, web and flange connected to the rockers. All live loads in the channel arm are transmitted through the ends of the rear floor beams to the bumpers, which are stirrup connected to the approach floor beam. The approach floor beam is web and flange connected to the approach girder, which engages anchors at each end.

The operating mechanism is standard on all of the Gowanus Canal bascule bridges and, excepting the main pinions and racks, in interchangeable. The racks on this bridge are fastened to the approach girders at the level of the pitch line.

The moving leaves were erected as follows: First the rocker girders were set on the tracks and then the floor beam nearest the tail end was put in place and the stringers carrying the counter weights put in. Then, by springing apart the outer ends of the rocker girders, the remaining floor beams were dropped in place and bolted up.

The estimated quantities for one bridge are: Steel, 180 tons; cast-iron counter weights, 230 tons, and machinery, 15 tons.

No. 6—Washington Avenue Bridge Over Wallabout Canal—

The present structure was opened to street travel on November 29, 1893, and is in excellent condition. It was built by the Kings Bridge Company and is a plate girder retractile bridge operated by electricity. The bridge is of trapezoidal shape and is 123 feet long on the centre line, with two roadways each 15 feet 6 inches wide.

An electric capstan for towing vessels through the draw has been installed, as so many boats were hauled through by hand. By this means the delays have been materially reduced; where it took 10 to 15 minutes by hand, the capstan has reduced the time for opening to an average of 3 minutes.

This capstan was also used to operate the bridge while repairs were being made to the usual opening machinery.

Painting was done in July, 1902, and in February, 1904, and the roadways were paved with 3-inch creosoted yellow pine blocks in January, 1903. This pavement, except for cracks in the blocks due to the uneven plank base, has given good service.

No. 7—Metropolitan Avenue Bridge Over Newtown Creek—

This bridge was built in 1884 to replace two bridges a few hundred feet west of the present location. One of the old bridges carried Metropolitan avenue over this branch of Newtown Creek, and the other bridge carried Grand street across the same waters.

The bridge was placed at the intersection of the two streets, which cross each other at an angle of about 20 degrees, and serves the travel on both streets. To allow this arrangement to be made a new creek channel was dredged to suit the new location.

The bridge is a centre bearing swing, with through pin connected trusses; is 174 feet long, and the roadway is 20 feet wide. The bridge is operated by electricity furnished by the railroad company, whose cars pass over the bridge.

Painting was done in July, 1902, and again in August, 1903. The crib bulkheads have been rebuilt and cement walks laid on the approaches. New hand rails have been placed on the bridge and approaches, and the sidewalk, plank and stringers have been renewed. End lifts were installed in August, 1903. They are of the semi-toggle principle, operated by electricity and work smoothly and quickly.

Changes have been made in the abutments which allow the bridge to be opened in either direction and turned through the full circle of 360 degrees, which reduces the time of openings.

A 3-inch wood block pavement, similar to that on the Washington Avenue Bridge, was laid by the railroad company in the spring of 1903, and has given satisfaction. The unused land on the sides of the approaches has been parked, and the appearance of the bridge greatly improved.

The channels were dredged on May 12, 1904.

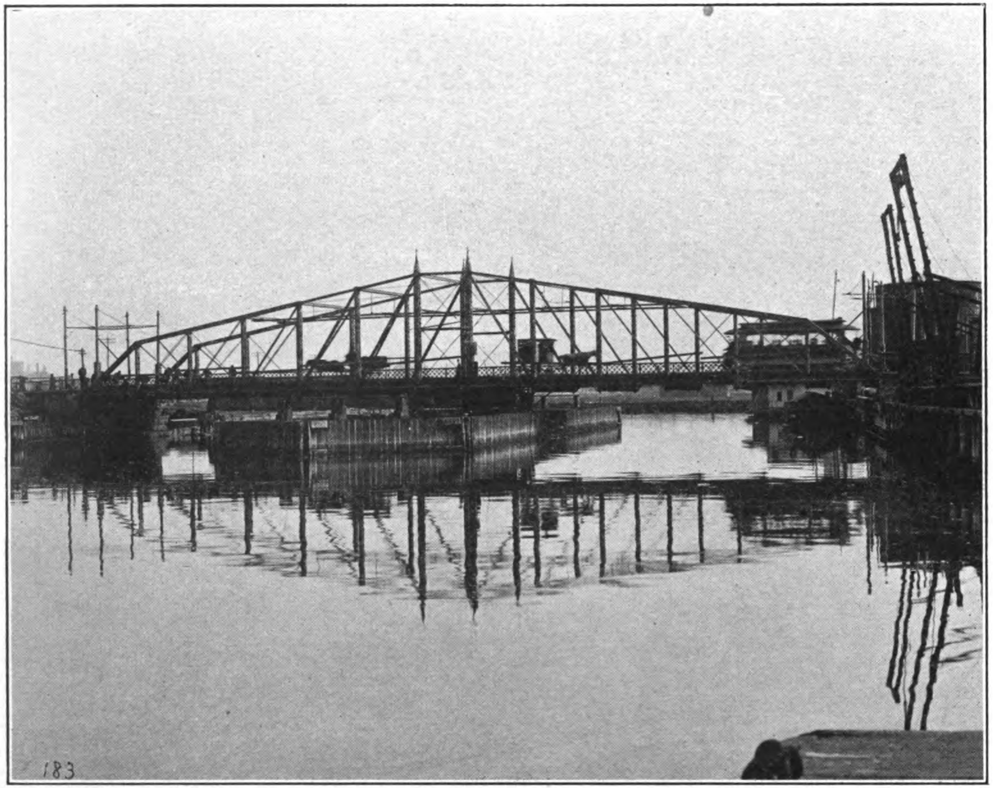
A new bridge is needed here with a wider roadway to accommodate the greatly increasing travel.

No. 8—Harway Avenue Bridge Over Coney Island Creek—

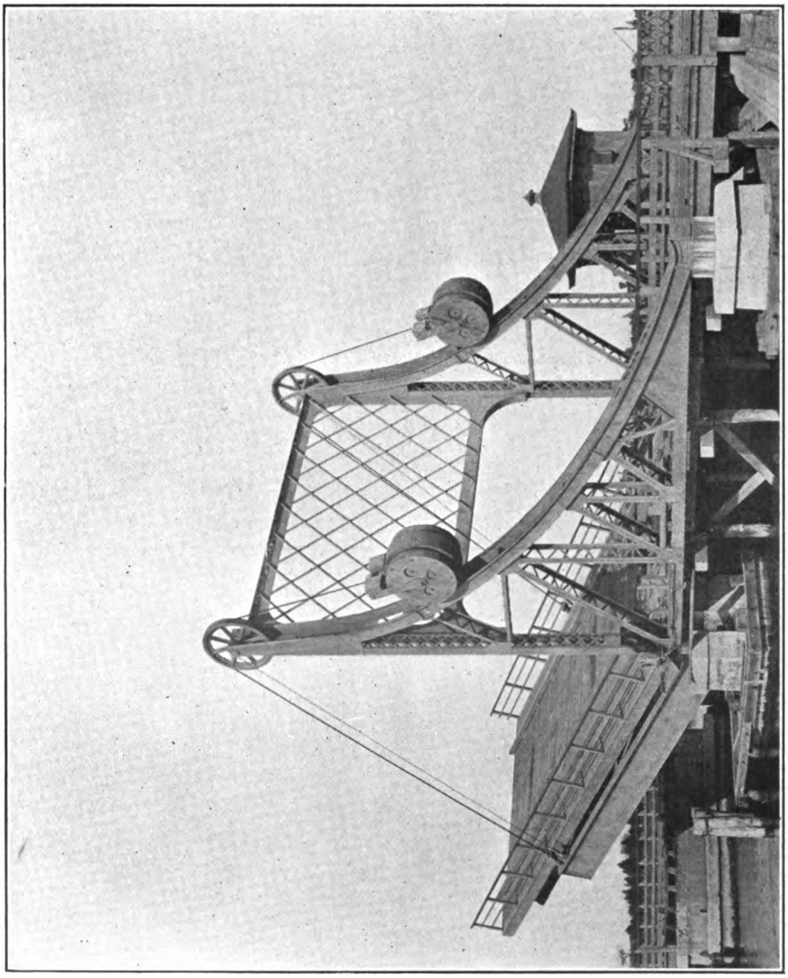
This is a plate girder hinged bascule bridge with the counterweights rolling on vertically curved tracks. The draw span is 50 feet long, with 300 feet of pile trestle approaches; the roadway is 20 feet wide and the waterway is 35 feet wide.

The bridge was completed in 1898 by Dean & Westbrook, and the shop work was done by the Canton Bridge Company.

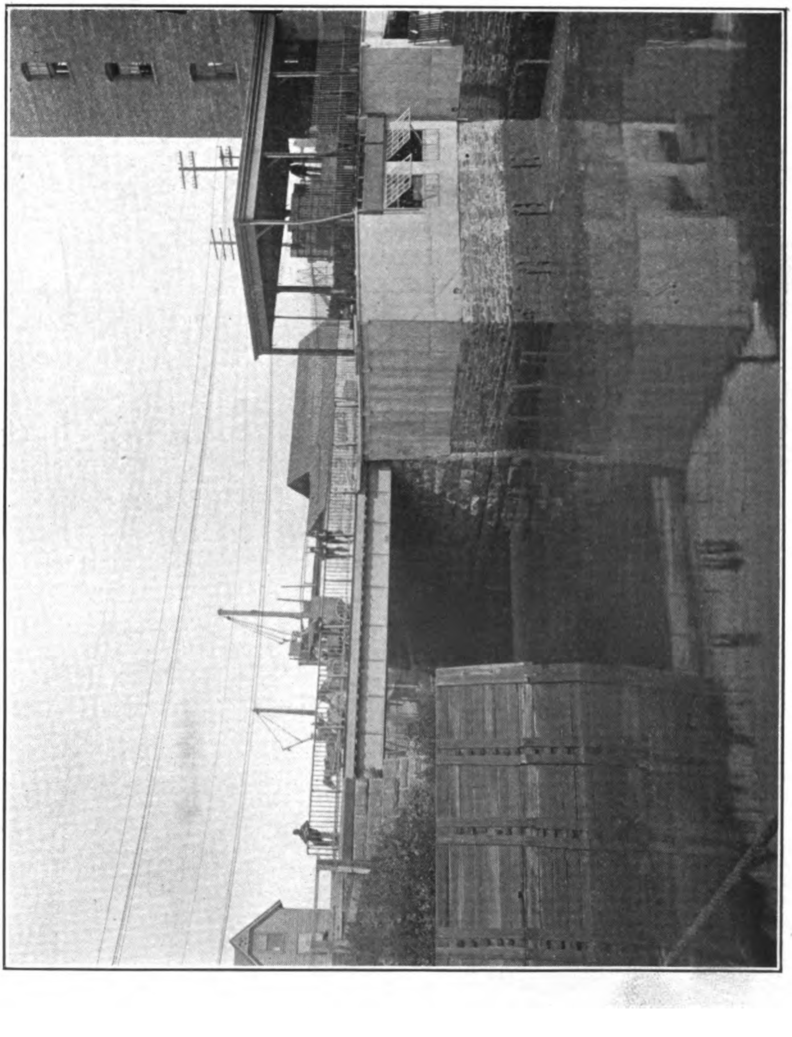
The bridge has given satisfactory service and is in excellent



METROPOLITAN AVENUE, BROOKLYN BOROUGH.



HARWAY AVENUE BRIDGE, BROOKLYN BOROUGH.



THIRD AVENUE BRIDGE, GOWANUS CANAL, BROOKLYN BOROUGH.

condition. It is raised by two five horse-power motors, with 220 volt current furnished by the Edison Company.

Painting was done in September, 1904.

No. 9—Third Avenue Bridge Over Gowanus Canal—

This is a fixed plate girder bridge of 40 feet span and 20 feet headroom, with an asphalt roadway 42 feet wide. It was built in 1889 and is in excellent condition.

During the year the bridge has been painted, the asphalt roadway repaired and riveting repairs made.

Borough of Richmond.

No. 1—Lemon Creek Bridge at Princess Bay—

This is a small wooden retractile bridge, opening by rolling back over the roadway approach and perpendicularly to the stream.

Temporary repairs were made early in 1902 to make the bridge safe until funds were provided for a new bridge. The bridge is now beyond repairing, and as a new bridge will be located on the site of the old one, a temporary bridge should be built in 1905, which will serve the double purpose of quickly providing safe facilities for crossing the creek and allowing the new bridge to be built without interrupting travel.

No. 2—Fresh Kills Bridge, Near Richmond—

This is a light centre bearing swing bridge 95 feet long with through trusses of angle irons. It was built by the Berlin Bridge Company in 1895 and is in good condition. The centre pier and abutments are founded on cast-iron piles of star cross section. There are 1,900 feet of pile trestle approaches over the meadows and creeks.

The bridge was painted in October, 1902, and in September, 1903; 240 roadway plank—3 inches by 10 inches yellow pine—were laid in 1902, and in December, 1904, 500 pieces of 3-inch yellow pine plank were put down. The pile trestle approach should be replaced with an embankment by the time the piles and timbering begin to fail from old age.

The earth fill, with a macadam covering, would pay for itself in lower maintenance charges, while giving an improved roadway.

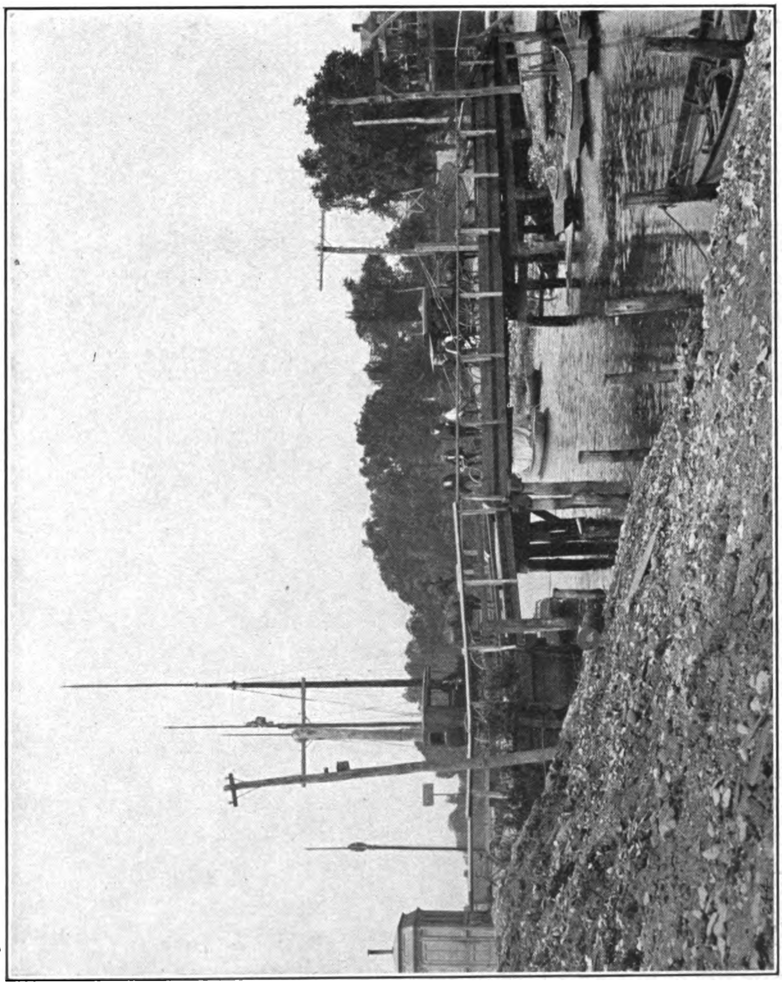
General—

The accompanying tables show the relation of each bridge to street and water travel for 1902, 1903 and 1904, a five years' census table of street travel at Hamilton Avenue Bridge, and a table of data concerning the new Gowanus bridges are also shown.

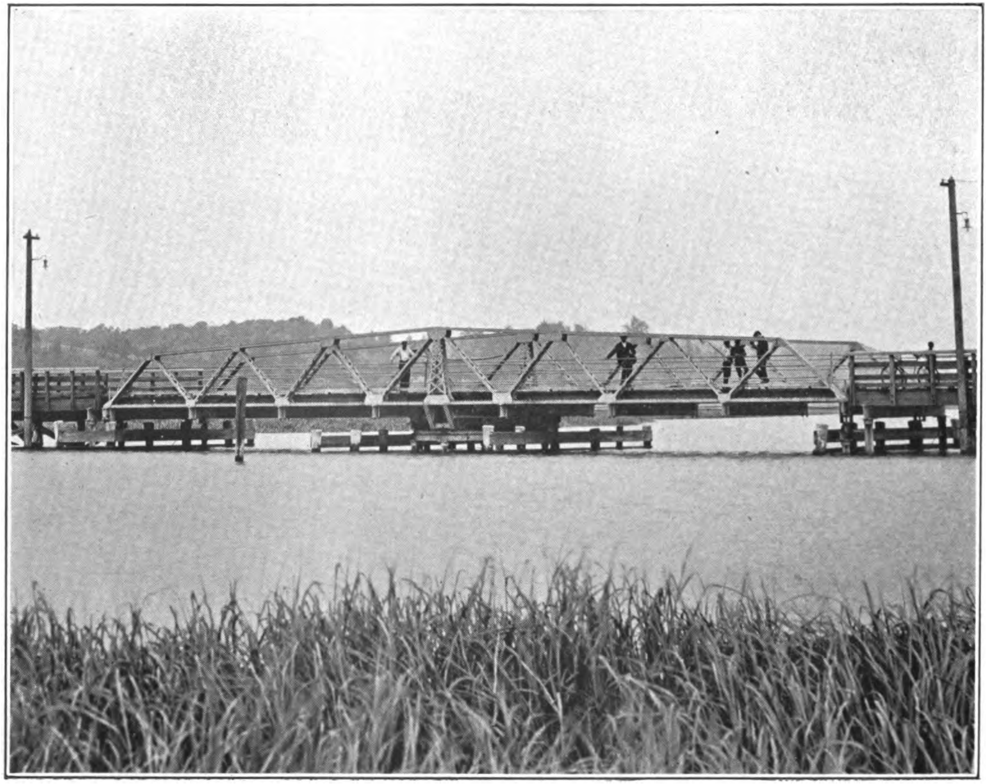
The borough office was removed on March 28, 1904, to the corner of Hamilton avenue and Smith street, for greater convenience in looking after the increased work on Gowanus Canal.

Respectfully submitted,

J. S. Langthorn,
Engineer in Charge.



LEMON CREEK BRIDGE, RICHMOND BOROUGH.



FRESH KILLS BRIDGE, RICHMOND BOROUGH.

Table of Bridge Openings for 1902.

Borough of Brooklyn.

Bridges.	Openings. Total.	Openings. Daily Average.	Vessels. Total.	Vessels. Daily Average.
Hamilton Avenue	9,717	31.85	28,327	93
Ninth Street	9,089	29.20	23,624	76
Third Street	5,587	18.31	13,746	45
Carroll Street	4,673	15.32	8,864	29
Union Street	2,199	7.20	6,652	22
Washington Avenue	4,546	14.90	4 528	15
(Capstan tows)	3,698	12.12	....	..
Metropolitan Avenue	5,641	18.49	10,352	34
Harway Avenue	270	0.88	348	1

Borough of Richmond.

Fresh Kills	68	0.22	68	..
Lemon Creek	192	0.62	192	..

Table of Bridge Travel on Wednesday, June 25, 1902.

Borough of Brooklyn.

From 4 A. M. to 8 P. M.

	Hamilton Avenue.	Ninth Street.	Third Street.	Carroll Street.	Union Street.	Washington Avenue.	Metropolitan Avenue.	Harway Avenue.
Vehicles	2,200	997	1,231	2,150	1,395	4,229	2,601	635
Cars	1,480	1,069	....	....	....	539	381	....
Pedestrians	3,175	2,103	2,888	2,996	3,243	4,618	5,119	541
Persons in vehicles (two each)	4,400	1,994	2,462	4,300	2,790	8,458	5,202	1,270
Bicycles	....	3	18	198	27	56	38	....
Persons in cars	30,100	20,571	....	....	....	6,920	7,538	....
Total persons	37,675	24,671	5,368	7,494	6,060	20,052	17,897	1,811

Table of Bridge Openings for 1903.

Borough of Brooklyn.

Bridges.	Openings. Total.	Openings. Daily Average.	Vessels. Total.	Vessels. Daily Average.
Hamilton Avenue	10,540	34.5	31.382	102
Ninth Street	10,197	33.4	25,116	82
Third Street	6,182	20.3	15,677	51
Carroll Street	4,804	15.8	9,689	32
Union Street	2,067	6.8	7,680	25
Washington Avenue	4,369	14.3	4,706	15
(Capstan tows)	3,636	12.	....	..
Metropolitan Avenue	6,079	19.9	11,687	38
Harway Avenue	504	1.7	701	2

Borough of Richmond.

Fresh Kills	23	....	23	..
Lemon Creek	215	....	229	..

Table of Bridge Travel on Friday, June 26, 1903.

Borough of Brooklyn.

From 4 A. M. to 8 P. M.

	Hamilton Avenue.	Ninth Street.	Third Street.	Carroll Street.	Union Street.	Washington Avenue.	Metropolitan Avenue.	Harway Avenue.
Vehicles	1,978	1,410	1,254	1,651	1,470	3,260	3,200	795
Cars	1,234	858	....	....	....	390	382	....
Pedestrians	3,012	3,304	2,888	2,553	3,390	4,020	5,130	568
Persons in vehicles (two each)	3,956	2,820	2,508	3,302	2,940	6,520	6,400	1,590
Bicycles	....	....	....	183	....	....	....	....
Persons in cars	19,150	23,450	....	....	....	9,250	8,000	....
Total persons	26,118	29,574	5,396	7,038	6,330	19,790	19,530	2,158

Table of Bridge Openings for 1904.

Borough of Brooklyn.

Bridges.	Openings. Total.	Openings. Daily Average.	Vessels. Total.	Vessels. Daily Average.
Hamilton Avenue	9,720	32.	28,341	93.
Ninth Street	9.448	31.	22,699	74.
Third Street	......	Under construction.		
Carroll Street	4,001	13.	8,272	27.
Union Street	......	Under construction.		
Washington Avenue	4,533	15.	4,737	16.
(Capstan tows)	......	....	4,093	13.
Metropolitan Avenue	6,656	22.	13,461	44.
Harway Avenue	477	1.5	667	2.

Borough of Richmond.

Fresh Kills	11	....	11	..
Lemon Creek	149	....	149	..

Note.—305 days taken for averages.

Records.

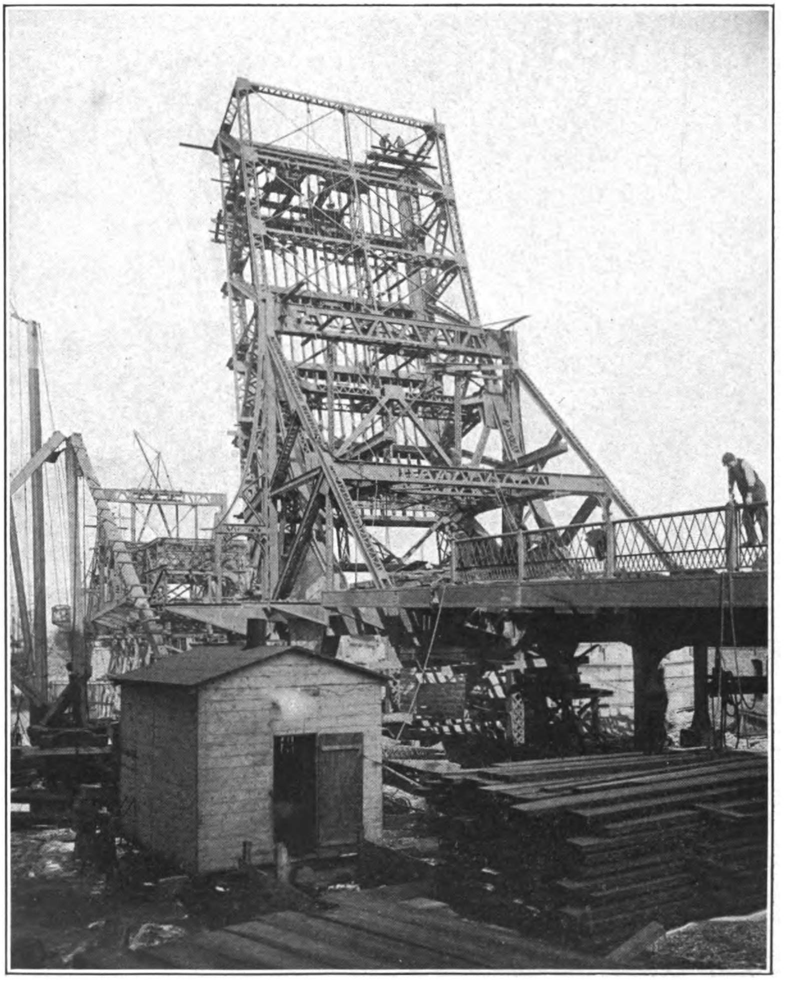
Hamilton Avenue Bridge.

Street Travel Over Bridge from 4 A. M. to 8 P. M.

	Friday, June 26, 1903.	Wednesday, June 25, 1902.	Thursday, June 27, 1901.	Tuesday, June 19, 1900.	Wednesday, December 27, 1899.
Vehicles	1,978	2,200	1,828	1,900	1,370
Cars	1,234	1,480	715	593	606
Foot passengers	3,012	3,175	2,150	4,480	2,040
Passengers in vehicles at 2 each	3,956	4,400	3,656	3,800	2,740
Persons in cars	19,150	30,000	17,223	11,148	7,485
Total persons	26,118	37,575	25,572	19,428	12,265

Data for New Bridges Over Gowanus Canal.

Bridge.		Estimated Cost.	Average of Daily Openings for 5 Years, 1898-1902.	Average Time Per Opening.	Street Travel Delay for Openings, 1902.		Average of 4 Years, 1899 to 1902.					Headroom at High Water.	Channel Width.	Channel Depth.	Elevation of Abutment.	Roadway Width.	Sidewalk Width.	Operating Power.	Type.
					Total for Year.	Daily Average.	Vessels Per Year.	Vessels Per Day.	Masted Vessels Per Day.	Vessels Without Masts Per Day.	Vessels Under Bridge Per Day.								
				Min.															
Hamilton Ave.	old..	....	36.2	3.93	637 hrs.	2 hrs. 5 min.	26,680	87	9	78	15	7′	34′	12′	9.85	22	5′	Electric.	Swing.
	new.	$175,000	....	2½	....	....	......	..	..	..	..	18′	50	12′	19.80	35′	6′	Electric.	Bascule.
Ninth St.	old......	....	27.7	3.36	501 hrs.	1 hr 38 min.	24,548	80	8	72	12	7′	32′	11′	10.0	19′ 6″	4′	Electric.	Swing.
	new.......	80,000	....	2½	....	....	......	..	..	..	..	8′	50′	12′	10.0	35′	6′	Electric.	Bascule.
Third St.	old.......	....	19.6	5.79	539 hrs.	1 hr. 48 min.	14,667	48	4	44	4	3′	31′	8′ 6′	5.5	17′	4′	Hand.	Swing.
	new.......	90,000	....	2½	....	....	......	..	..	..	..	8′	50′	10′	10.0	30′	6′	Electric.	Bascule.
Union St.	old.......	....	8.8	6.50	240 hrs.	48 min.	7,227	24	2	22	7	10′	32′	8′	11.2	17′	3′ 6″	Hand.	Swing.
	new.......	80,000	....	2½	....	....	......	..	..	..	..	9′	50′	9′	11.2	35	6	Electric.	Bascule.



VERNON AVENUE BRIDGE, NEWTOWN CREEK.

Bridges Over Newtown Creek and in the Borough of Queens.

December 31, 1904.

O. F. Nichols, Esq.,
Chief Engineer, Department of Bridges:

Dear Sir—I submit the following report as to the bridges under my charge.

Bridges Over Newtown Creek.

Newtown Creek forms the boundary between the boroughs of Brooklyn and Queens for a distance of nearly four miles, and is navigable for the greater part of this distance. The creek for its greater part is 250 feet in width, with a depth of water of 23 feet at mean high tide. Its commerce is greater than that of any similar waterway in this part of the country.

The creek is spanned by five bridges under my jurisdiction.

No. 1—The Vernon Avenue Bridge—

By constant care the old bridge was kept in commission and was finally closed to traffic on December 26, 1902, on the opening of the temporary bridge at East avenue. It was fortunate that no serious accident occurred during the latter part of its service, as its condition was very bad when it was closed to traffic.

The new bridge now in course of construction is located about 1,500 feet above the mouth of the creek, and when completed will be the main connecting link between the boroughs of Brooklyn and Queens. The contract for this bridge, which included the construction of the temporary bridge mentioned above, was awarded to the United Engineering and Contracting Co. on December 9, 1901, at an estimated cost of $547,046. On January 1, 1904, the contract was 41 per cent. completed, and on December 31, 1904, is 79 per cent. completed.

The delay in acquiring land for the bridge approaches and the laying of trolley tracks on the bridge by this department has delayed the completion of the structure, and July 1, 1905, may be set as the date of final completion.

General description of the bridge: The length is 1,699 feet, 332 feet of which are taken up by the Scherzer span. The Brooklyn approach is 334 feet in length and the Queens approach is 1,033 feet. This long approach on the Queens side is necessary to obviate the crossing at grade, the tracks of the Long Island Railroad, some 400 feet north of the creek.

It might be mentioned here that the original plans permitted no means of access to the bridge except from either terminal, and plans have been made for the construction of two stairways at the corner of Borden avenue to allow of access at that street.

The roadway, on which a double trolley track will be laid, is 40 feet in width and two sidewalks each 8 feet in width are provided.

The approaches consist partly of steel viaducts, with either buckle plate or trough plate floor, and partly of walls of limestone masonry, backed with Portland cement concrete, which retain the earth filling on which the pavements are laid. Asphalt and granite blocks, both on concrete foundation, are used for the roadway pavement of the approaches. The sidewalks are of Portland cement concrete.

The Scherzer span consists of a double leaf through span with a length of 172 feet between centres of bearings (providing a single channel 150 feet in width), and two approach fixed spans, each 80 feet in length. Each leaf has two trusses, 45 feet centres, and is so counterbalanced that it is at rest in all positions, and when closed to receive land traffic acts as a cantilever whose anchors extend from its top chord down through the anchor piers some 16 feet below high water. This span with its clear roadway of 40 feet necessitating 45 feet truss centres is, I believe, the largest double leaf highway bridge of this design (Scherzer).

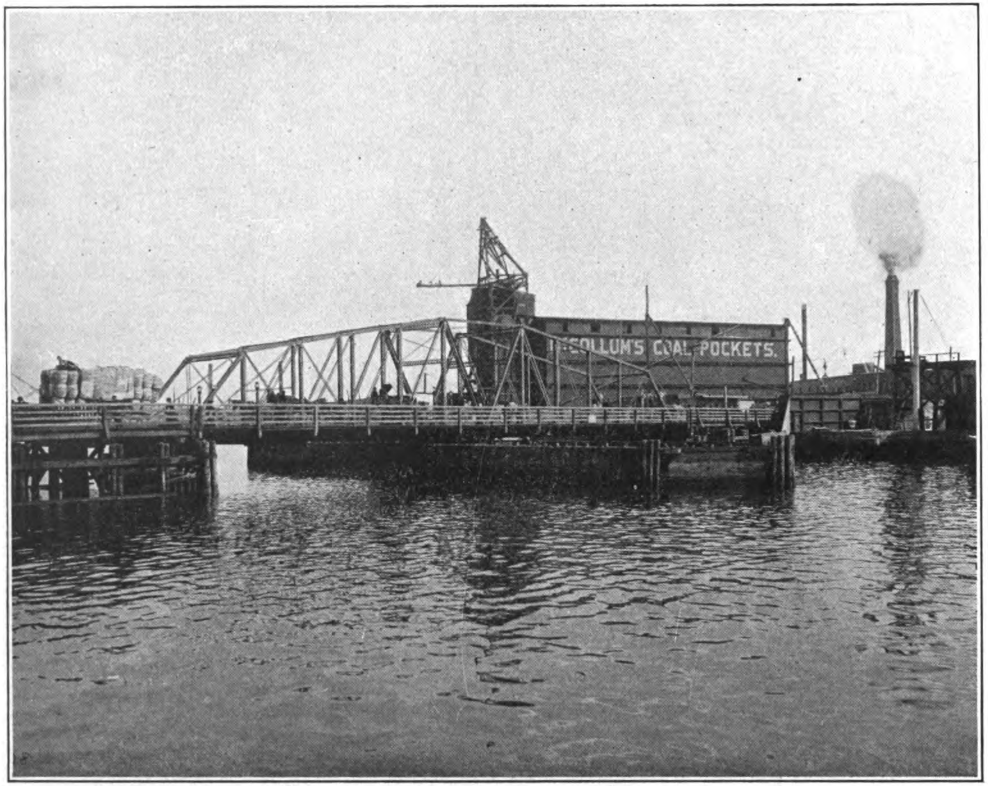
Electricity is the motive power, and the control is so devised that each leaf can be operated separately from its side of the creek and by means of submarine cables, etc., the control of both leaves will be located on one side of the creek.

This bridge, eliminating as it does the centre pier, which is necessary for the turn bridge, and providing for a height of channel of 24 feet in the clear, will no doubt be the forerunner of bridges of similar design to replace all the draw bridges on this creek.

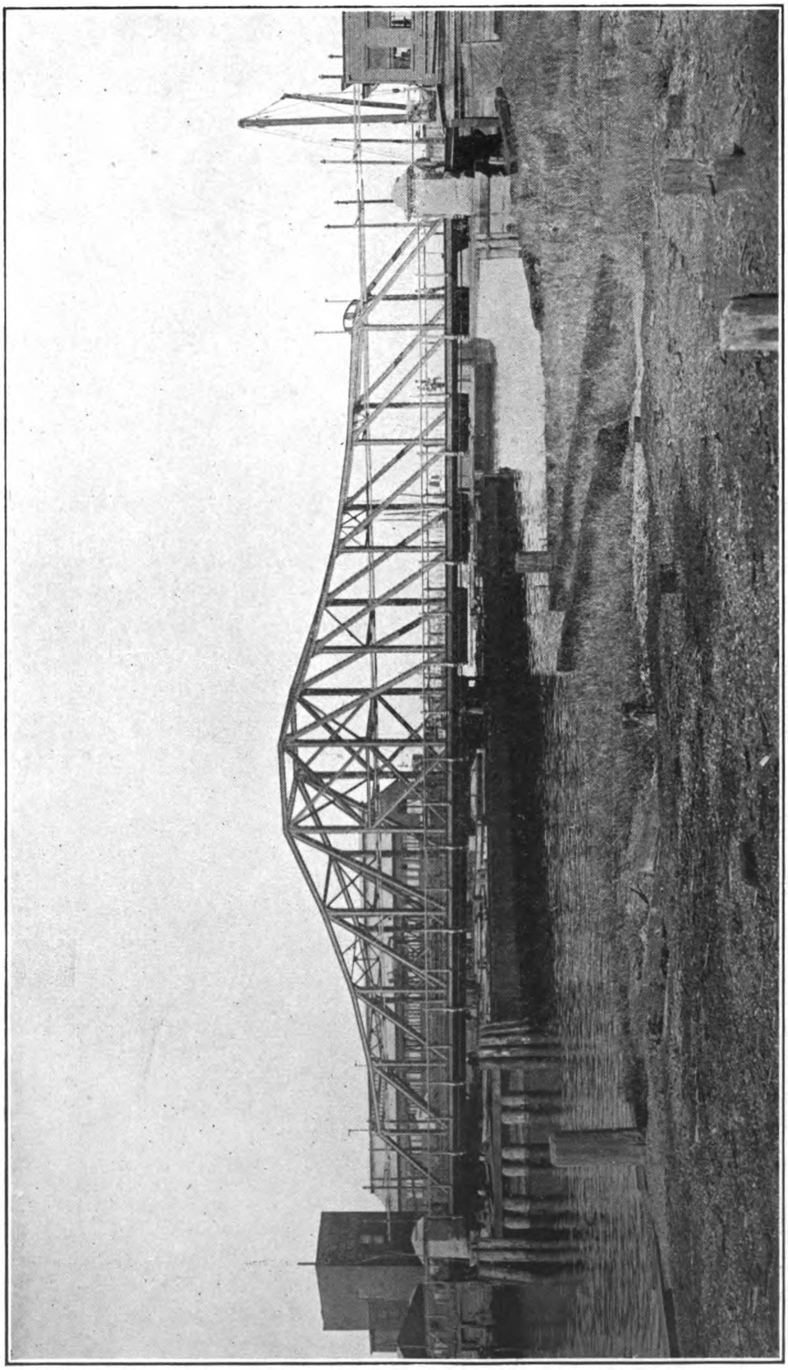
It is expected that 50 per cent. of the water traffic will pass this bridge without necessitating the interruption of land traffic.

The matter of acquiring additional land by the City at the northeast corner of Vernon avenue and Fourth street, Long Island City, for the purpose of forming a plaza and an adequate entrance to this bridge is again suggested, as the need of it will be shown as soon as traffic is turned on this structure.

The property at the southwest corner of Manhattan avenue



TEMPORARY BRIDGE, EAST AVENUE, NEWTOWN CREEK.



GREENPOINT AVENUE BRIDGE, NEWTOWN CREEK.

and Ash street taken by the City as an addition to the Brooklyn approach to this bridge will be available early in 1905, and the necessary improvements for approach purposes will be made at the time the changes in grades of the streets leading to the bridge approach are made.

The temporary bridge at East avenue has required considerable repair in its operating machinery, due to the settlement of the pile and timber centre pier. The roadway planking has been renewed twice during the year, and during the coming spring a partial renewal of the planking will be necessary. The heavy land traffic over this bridge is next in importance to that of the East river bridges as the records will show, while the water traffic passing through the channel is greater than that at any draw bridge in this section of the country.

Carelessness on the part of captains of vessels has been the cause of serious damage at times. On one occasion the captain of one of these boats damaged the end floor girder so badly that vehicle traffic was suspended. He was summoned to court and charged with maliciously damaging the bridge, but discharged. A suit for the recovery of the cost of repairing this damage resulted in a judgment in favor of the City for the full amount claimed, $182.25, which has been paid; the first instance, I am informed, of bills of this kind having been collected by the City.

On December 7, 1903, a steam lighter attempted to force the draw span open during the morning half hour when it is closed to navigation. The sidewalk stringers and planking were badly damaged, and bills have been made against the owners to cover the cost of repairs.

It will be a great relief when the new bridge is completed and this temporary bridge removed, as the latter has been a great annoyance to the public, and an expensive structure to maintain.

No. 2—Greenpoint Avenue Bridge—

This bridge has been thoroughly overhauled, and is now in good condition.

The aprons at the ends of the draw spans have been removed. They were of little use, and as they were operated by the shaft that operates the end wedges they were a source of trouble if the wedges failed to work satisfactorily.

Considerable trouble has been caused by the bolts holding the operating rack becoming loose and the rack getting out of

position. This has been gone over thoroughly, and the rack is now in good condition and working satisfactorily.

Stationary signal lamps, showing white and red, have been placed at the ends of the draw span.

Hanging platforms, affording an easy means of oiling, adjusting and repairing the end-operating machinery, have been erected at the ends of the draw span.

The entire structure, including railing and shelter house, has been painted.

No. 3—Meeker Avenue Bridge—

Early in 1902 it was found necessary to remove the centre discs, their oil grooves being entirely worn down, leaving no means of lubrication. New oil grooves were scored and new oil pipes installed in place of the old ones which failed in their duty.

This draw span has been equipped with an electric motor, and is now working satisfactorily.

The entire structure has been thoroughly overhauled, all the timber stringers, planking, etc., removed, and the steel cleaned and painted. An under deck of yellow pine timber has been laid, on which a four-ply waterproof coat of felt and tar has been placed. On this has been laid a wearing surface of creo-resinate blocks, with sand and tarred joints.

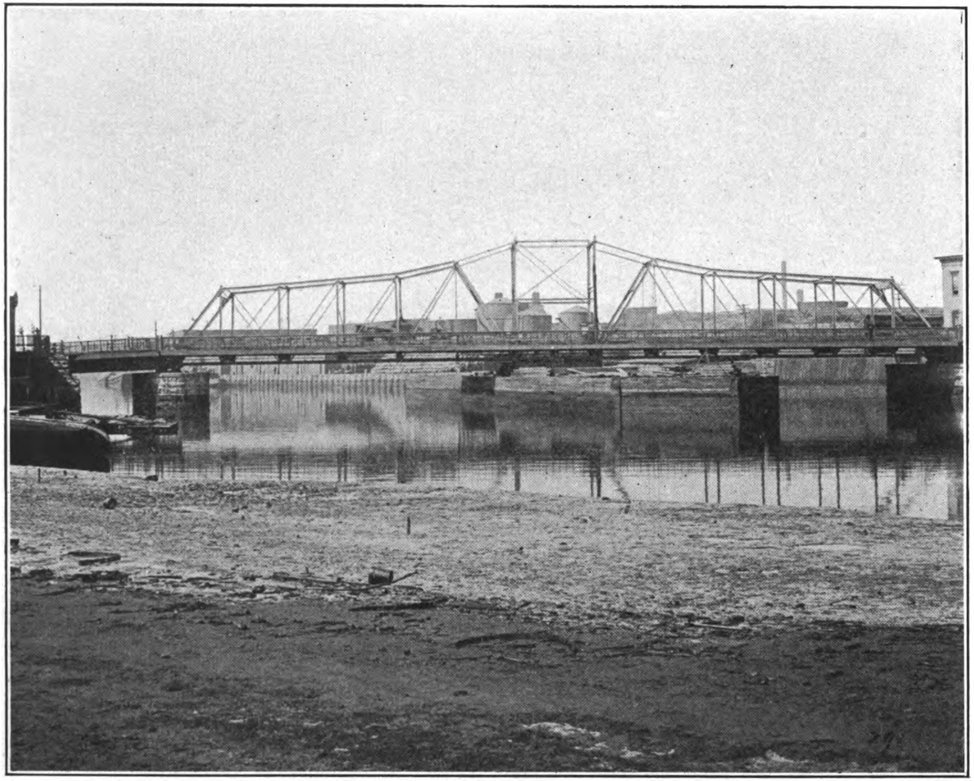
The railing has been changed in design, new gate-posts erected and suitable drains and catch-basins provided.

Stationary signal lamps, showing white and red, have been placed at the ends of the draw span.

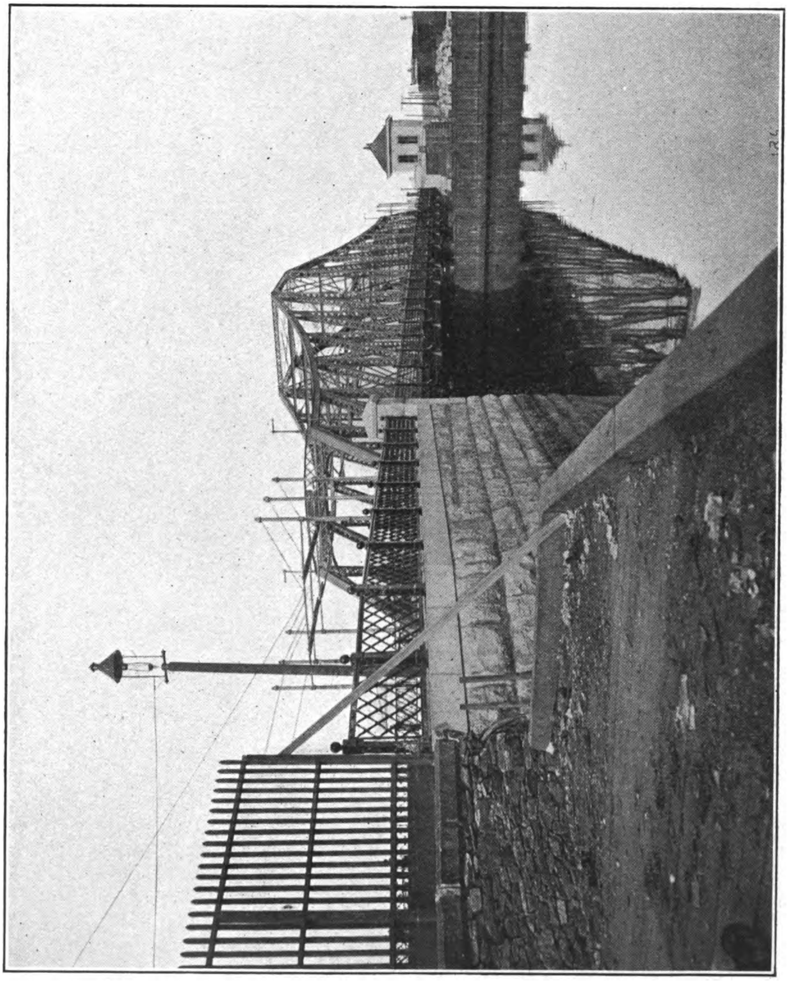
A timber platform has been erected around the centre pier, which serves as an easy means of oiling, repairing, etc.

The damage to the draw span by the schooner "Charles Endicott," while being towed through the channel by the tugs "Starbuck" and "Boy," on November 29, 1904, has been repaired, and the bill of cost of repairs has been sent to the owners of tugs which caused the accident.

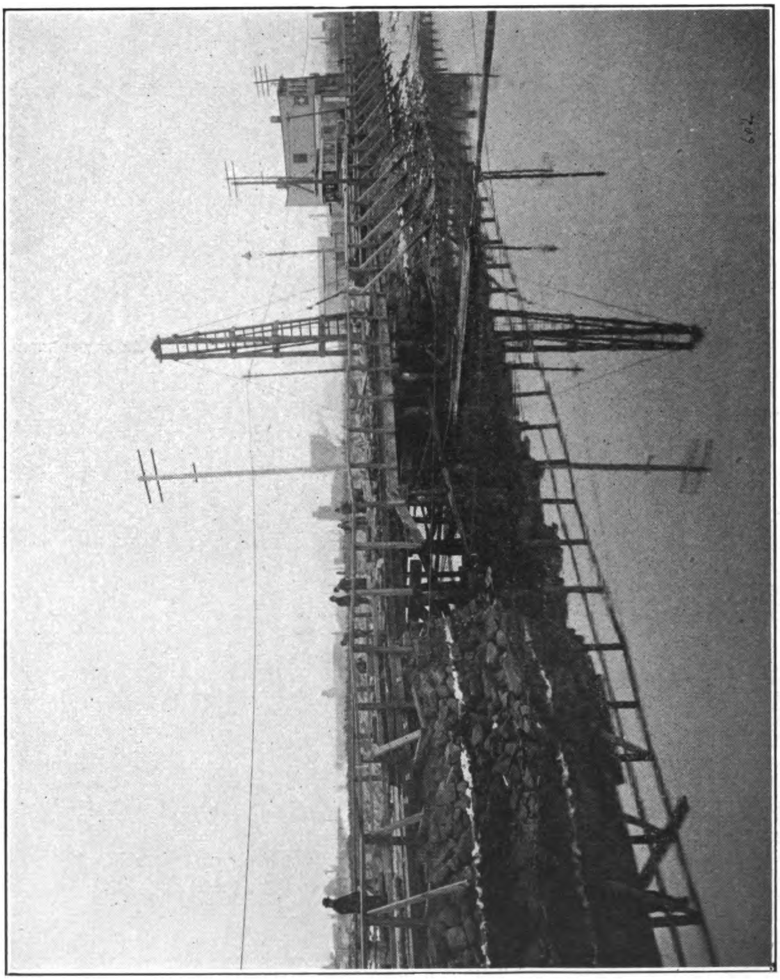
I recommend the reconstruction of the Greenpoint Avenue and the Meeker Avenue bridges as soon as possible, to allow a clear channel with clearance under the bridges of 24 feet above high water (the same as at the Vernon Avenue Bridge now building), and by means of viaducts on the Queens side of the creek in both cases, the abolition of the dangerous grade crossings of the Long Island Railroad, which occur within a few hundred feet of these bridges.



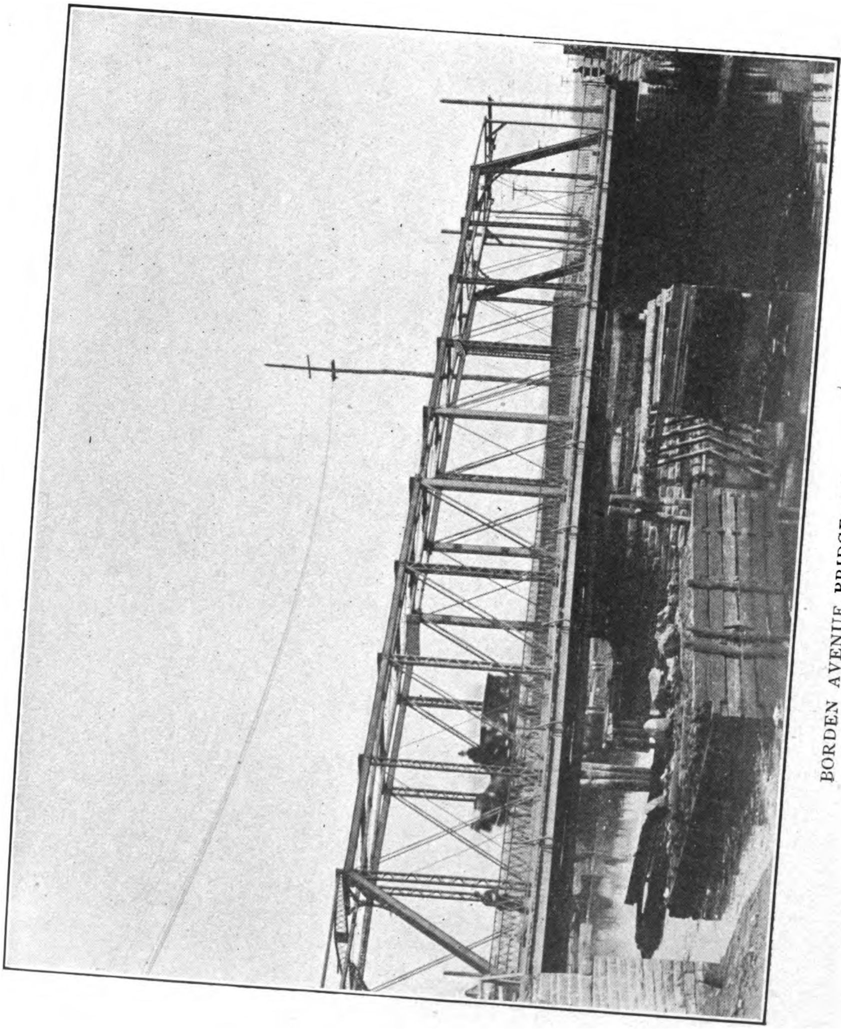
MEEKER AVENUE BRIDGE, NEWTOWN CREEK.



GRAND STREET BRIDGE, NEWTOWN CREEK.



METROPOLITAN AVENUE BRIDGE, NEWTOWN CREEK.



BORDEN AVENUE BRIDGE, QUEENS BOROUGH.

No. 4—Grand Street Bridge—

The contract for the construction of this bridge was awarded to Bernard Rolf, on August 7, 1900, at an estimated cost of $173,-379.90. The bridge should have been completed on October 21, 1901, but it was fourteen months later, December 26, 1902, before it could be used, and then for only part of the day; and it was not until February 5, 1903, that it was accepted and declared open for traffic.

The contractor presented claims for extra allowances, and a committee, consisting of the late Mr. C. C. Martin, Consulting Engineer; the then Deputy Commissioner, and the Engineer in Charge, reported a finding, which was accepted by the contractor and the City. The total cost of the bridge was $172,748.06.

Several important changes were found necessary in the operating machinery; New end wedges have been put in place and steel bearings have replaced certain cast-iron ones. One hand-turning gear has been installed. Stationary signal lamps, showing white and red, have been placed at the ends of the draw span. Hanging platforms have been erected at the ends of the draw span, and a platform built around the centre pier. These platforms have more than paid for themselves in the cost of repairs and erection. The railing has been painted, and the draw is working satisfactorily.

No. 5—Metropolitan Avenue Bridge, which is a fixed timber structure, situated at a part of Newtown creek which is not navigable, has been entirely reconstructed during the year 1904, with the addition of a sidewalk, which the old structure did not have.

Bridges in Borough of Queens.

No. 6—Borden Avenue Bridge, over Dutch Kills, is in a very bad condition. It has required considerable repair to keep it in operation to accommodate the water traffic, which has greatly decreased during the past two years. From the records, you will observe the very heavy vehicle traffic, which is steadily increasing, and steps should be taken for the reconstruction of this bridge during the coming year (1905).

The present bridge is badly located for roadway traffic, and the plans for the new bridge, which are now nearly ready, provide for a wider bridge, of the retractile type, affording a

straight course for roadway traffic and for a channel of maximum width. Test borings have already been made on the site of the foundation.

No. 7—Flushing Bridge Over Flushing Creek—

The old bridge over Flushing creek was originally designed for ordinary highway traffic, and was never intended for trolley cars. It was a light structure, with inadequate and cheaply built piers; the roadway was too narrow, with one railroad track located in the centre, so that when a car was on the bridge traffic in the opposite direction was impossible. It was decided in 1903 to rebuild it under a contract awarded to Snare & Triest Co. on April 15, 1904, at an estimated cost of $257,844. The work of building the temporary bridge was commenced on June 3 and bridge opened to all traffic on September 27, 1904. The superstructure of the old bridge has been removed, but, owing to the fact that the City had not taken title to the property required for the new bridge, no further work has been done. It is expected that work will be resumed the coming spring. The contract set the date of completion on October 1, 1905, but, owing to the delay in acquiring this property, this will be postponed until May, 1906.

No. 8—Strong's Causeway Bridge over Flushing Creek.

This bridge is in good condition and will no doubt care for the traffic for some time to come. The approaches have been raised to the level of the draw span, the west approach having settled over three inches at the draw span end.

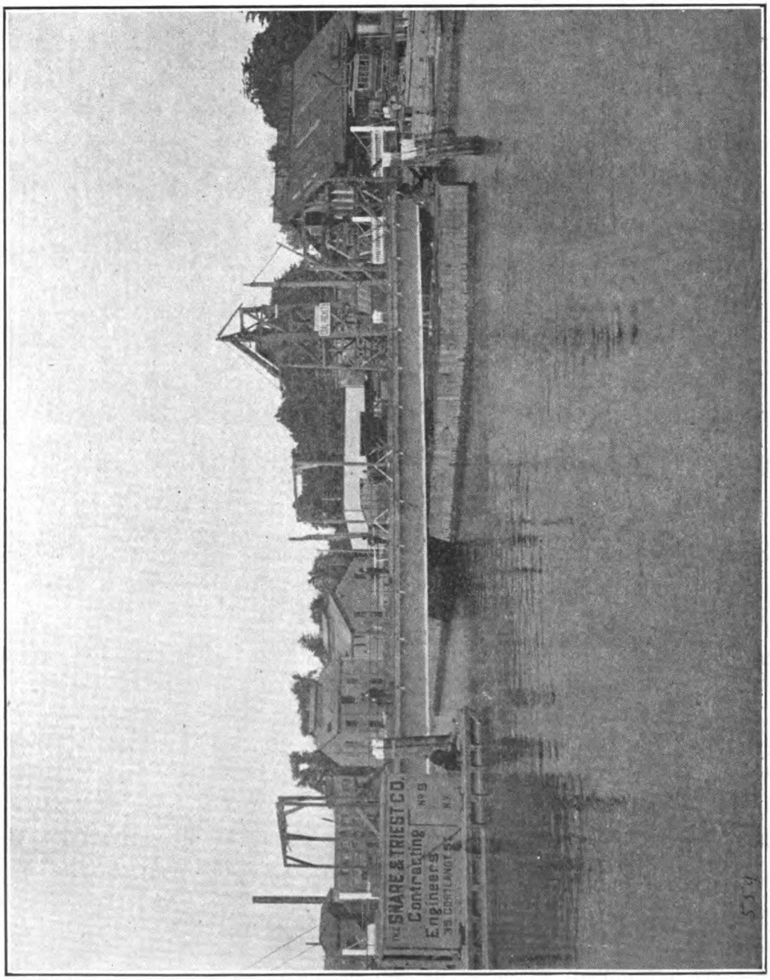
The Brooklyn Heights Railroad Company have replanked the entire roadway.

New end supports, which can be cleaned, oiled and properly adjusted, have been installed.

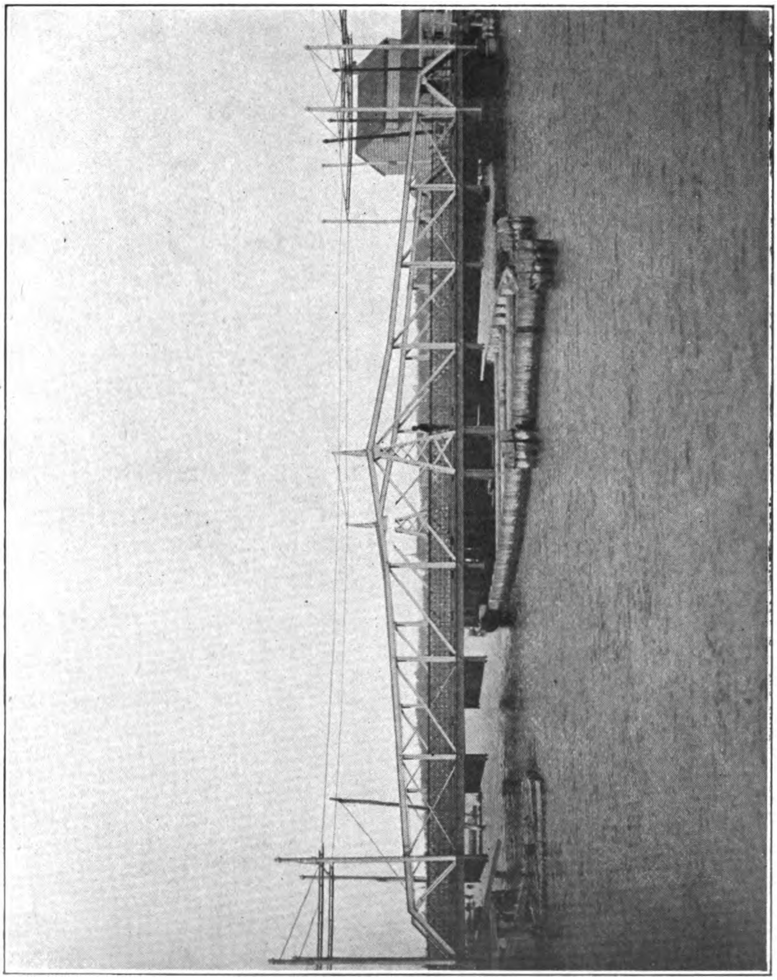
Drain pipes have been laid in the centre pier and the top of the pier concreted with a cement mortar finish, so that water, which was formerly impounded in the centre pier at the fall of the tide can now run off, thereby diminishing the corroding of the rack operating machinery.

The entire structure has been painted and the draw span is in good condition.

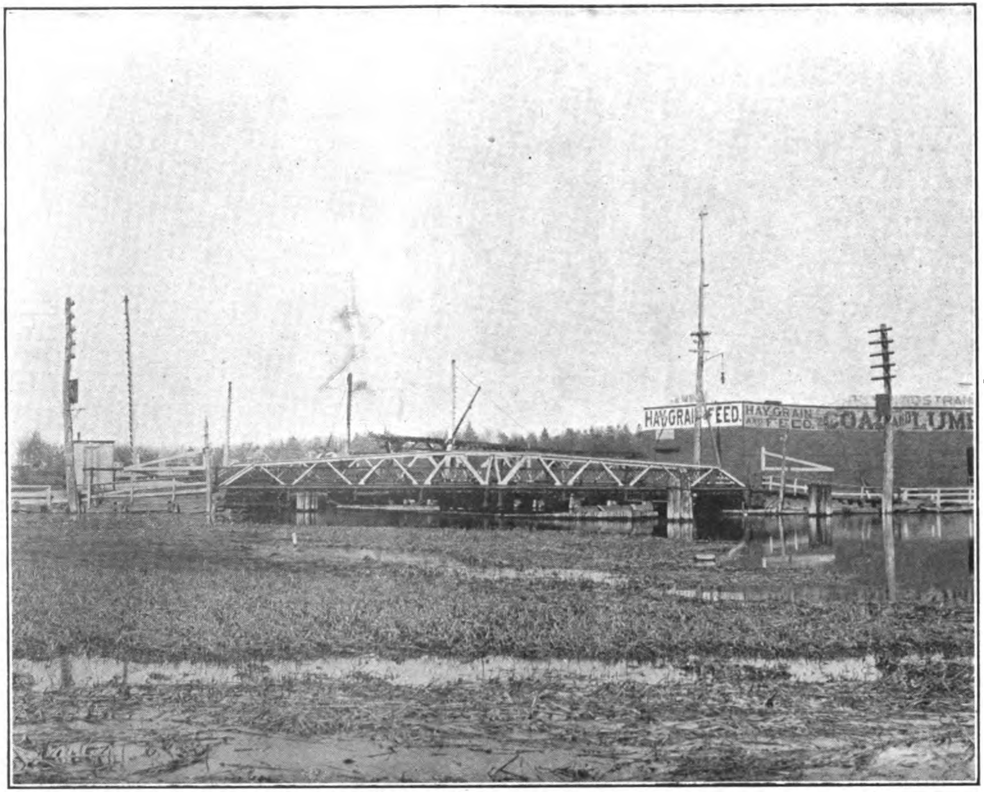
No. 9—Little Neck Bridge over Alley Creek, which is on the main line of traffic on the north shore of Long Island, and is the third link in the chain of bridges, considering Blackwell's Island Bridge as the first link and Flushing Bridge as the second, should



TEMPORARY BRIDGE, FLUSHING CREEK, QUEENS BOROUGH.



STRONG'S CAUSEWAY BRIDGE, QUEENS BOROUGH.



LITTLE NECK BRIDGE, QUEENS BOROUGH.

be reconstructed at an early date. All the lattice bars and tie plates of the bottom chords of the draw span have been renewed since 1901, the roadway planking and wheel guards have been renewed, the operating machinery put in good condition, the rest piers repaired and the bridge painted. The draw can only be opened at high tide, as the abutments move backward and forward with the tides. There were, however, only two openings in 1902 and no openings in 1904.

The reconstruction should mean the raising of and widening the existing roads for a distance of a thousand feet either side of creek as well as building of a modern bridge.

Openings of Bridges and Passage of Vessels at Bridges Over Newtown Creek and in the Borough of Queens.

Newtown Creek Bridges.

Name of Bridge.	1902.		1903.		1904.	
	Openings in 24 Hrs.	Vessels Passing in 24 Hrs.	Openings in 24 Hrs.	Vessels Passing in 24 Hrs.	Openings in 24 Hrs.	Vessels Passing in 24 Hrs.
Vernon Avenue	74	266	68	235	63	236
Greenpoint Avenue	62	167	62	120	62	109
Meeker Avenue	32	72	32	74	37	82
Grand Street	5	7	7	10	8	11

Borough of Queens Bridges.

	Yearly Openings and Vessels Passing.					
Borden Avenue	9c6	2,227	74	110	64	106
Flushing	950	1,418	1,011	1,501	1,008	1,425
Strong's Causeway	32	42	18	34	34	51
Little Neck	...	....	2	2	....	....

The land traffic over the bridges in Queens in twenty-four hours by actual count in September and October, 1904, is given in the following table, as well as the time consumed in openings, taken as an average for the three years, 1902, 1903 and 1904.

Name of Bridge.	Vehicles in 24 Hrs.	Foot Passengers in 24 Hrs.	Trolley Cars in 24 Hrs.	Time Taken for Openings for Year—Average of 3 Years.
	Average in 24 Hours of 3 Years.			
Vernon Avenue	1,888	18,653	....	6 h. 48 min.
Greenpoint Avenue	861	2,345	104	5 " 10 "
Meeker Avenue	1,070	3,686	...	2 " 58 "
Grand Street	967	2,290	270	0 " 46 "
	Yearly Average.			
Borden Avenue	1,092	1,435	120	157 " 31 " in 1902. 16 " 27 " in 1903, 15 " 8 " in 1904.
Flushing Avenue	602	706	465	159 " 11 "
Strong's Causeway	189	235	133	4 " 14 "
Little Neck	592	163	....	0 " 40 " in 1903.

Respectfully submitted,

EDWARD A. BYRNE,
Engineer in Charge, Borough of Queens and Newtown Creek Bridges.

APPENDIX A.

Bridges Over the East River.

No.	Name.	Water Crossing.	Terminals.	Height Above High Water.	Variety.	Approximate Cost of Construction Exclusive of Land.
				Feet.		
1	Brooklyn Bridge	East river	Park Row, Manhattan; Washington street, Brooklyn.	135	Suspension	$10,975,168
2	Williamsburgh Bridge	"	Clinton and Delancey streets, Manhattan; between Driggs and Roebling streets, Brooklyn	135	"	10,981,575
3	Manhattan Bridge	"	Canal street and Bowery, Manhattan; Nassau and Bridge streets, Brooklyn	135	"	*12,000,000
4	Blackwell's Island Bridge	"	Second avenue and Sixtieth street, Manhattan; Crescent and Jane streets, Queens	135	Cantilever	*10,000,000

Bridges Over the Harlem River.

No.	Name.	Water Crossing.	Terminals.	Height Above High Water.	Variety.	Approximate Cost of Construction Exclusive of Land.
1	Willis Avenue Bridge	Harlem river	One Hundred and Twenty-fifth street and First avenue, Manhattan; One Hundred and Thirty-fourth street and Willis avenue, The Bronx	29	Swing	†$1,657,000
2	Second Avenue Bridge (sidewalks)	"	Second avenue, Manhattan	32.25	"	....
3	Third Avenue Bridge	"	Third avenue, Manhattan, and The Bronx	27.6	"	1,768,830
4	Madison Avenue Bridge	"	Madison avenue, Manhattan; East One Hundred and Thirty-eighth street, The Bronx	20.29	"	498,881
5	One Hundred and Forty-fifth Street Bridge	"	One Hundred and Forty-fifth street and Lenox avenue, Manhattan; One Hundred and Forty-ninth and Exterior streets, The Bronx	30	"	*1,750,000
6	Macomb's Dam Bridge	"	One Hundred and Fifty-fifth street, Manhattan; Jerome avenue, The Bronx	34.48	"	1,359,694
7	N. Y. & Putnam R. R. Bridge (sidewalks)	"	Eighth avenue, Manhattan; Sedgwick avenue, The Bronx	32	"	4,887
8	Washington Bridge	"	West One Hundred and Eighty-first street, Manhattan; Aqueduct avenue, The Bronx	152.075	Steel arch	2,851,685
9	University Heights Bridge	"	Ninth avenue and Two Hundred and Seventh street, Manhattan; One Hundred and Eighty-fourth street and Harlem river Terrace, The Bronx	30.25	Swing	*1,186,000
10	Ship Canal Bridge	Harlem ship canal	Broadway, Manhattan	30	"	††476,866
10N	New Ship Canal Bridge	"	"	30	"	607,000
11	Farmers	Spuyten Duyvil creek	Farmers Bridge road, Manhattan; Kingsbridge road, The Bronx	3	Wooden	1,500
12	Broadway Bridge	Spuyten Duyvil creek	Broadway, Manhattan, and The Bronx	15.4	Plate girder	79,924
13	Kingsbridge	Spuyten Duyvil creek	Kingsbridge avenue, Manhattan, and The Bronx	4	Wooden	1,500

* Under construction. † Adding new approach. †† To be moved down to University Heights.

Bridges in the Borough of The Bronx.

No.	Name.	Water Crossing.	Terminals.	Height Above High Water.	Variety.	Approximate Cost of Construction Exclusive of Land.
				Feet.		
1	One Hundred and Thirty-fifth Street Bridge	Mott Haven canal	East One Hundred and Thirty-fifth street, The Bronx	10.5	Bascule	$30,000
2	Westchester Avenue Bridge	Bronx river	Westchester avenue	24	Draw, retractile	76,550
2T	Westchester Avenue Bridge (temporary)	"	Westchester avenue and turnpike	10	Pony swing	22,000
3	Unionport Bridge	Westchester creek	Sixth street and Eastern Boulevard	6	Swing	25,000
4	Pelham Bridge	Eastchester Bay	Pelham road	20	Bascule	*700,000
40	Pelham Bridge (old)	"	"	11	Swing	30,000
5	City Island Bridge	Pelham Bay (Narrows)	Pelham Bay Park and City Island	16.3	"	248,000
6	Eastchester Bridge	Hutchinson's river	Boston Post road	7	"	15,000

Bridges in the Borough of Brooklyn.

No.	Name.	Water Crossing.	Terminals.	Height Above High Water.	Variety.	Approximate Cost of Construction Exclusive of Land.
1	Hamilton Avenue Bridge	Gowanus canal	Hamilton avenue	20.67	Bascule	*$175,000
1T	Hamilton Avenue Bridge (temporary)	"	"	8	"	5,100
2	Ninth Street Bridge	"	Ninth street	11	"	*80,000
20	Old Ninth Street Bridge	"	"	11	Swing	30,000
3	Third Street Bridge	"	Third street	11	Bascule	*90,000
4	Carroll Street Bridge	"	Carroll street	7	Draw, retractile	29,600
5	Union Street Bridge	"	Union street	11.2	Bascule	*80,000
6	Washington Avenue Bridge	Wallabout canal	Washington avenue	7.6	Draw, retractile	50,000
7	Metropolitan Avenue Bridge	English kills	Metropolitan avenue	10.5	Swing	65,000
8	Harway Avenue Bridge	Coney Island creek	West Eighteenth and West Seventeenth streets	8	Bascule	25,000
9	Third Avenue Bridge	Gowanus canal branch	Third avenue	20	Fixed span	43,320

Bridges Over Newtown Creek and in the Borough of Queens.

1	Vernon Avenue Bridge	Newtown creek	Vernon avenue, Queens; Manhattan avenue, Brooklyn	28.6	Bascule	*$750,000
1T	Vernon Avenue Bridge (temporary)	"	East and Borden avenues, Queens; Ash and Oakland streets, Brooklyn	8.7	Swing	31,700
2	Greenpoint Avenue Bridge	"	Greenpoint avenue, Queens, and Brooklyn	12.39	"	84,000
3	Meeker Avenue Bridge	"	Meeker avenue, Queens, and Brooklyn	14.43	"	142,500
4	Grand Street Bridge	"	Grand avenue, Queens, and Brooklyn	11.17	"	199,690
5	Metropolitan Avenue Bridge	"	Metropolitan avenue, Queens, and Brooklyn	4.40	Wooden trestle	4,000
6	Borden Avenue Bridge	Dutch kills	Borden avenue, Queens	10.44	Swing	25,000
7	Flushing Bridge	Flushing creek	Jackson avenue and Broadway, Queens	15	Bascule	*325,000
7T	Flushing Bridge (temporary)	"	" "	11.75	Swing	31,600
8	Strong's Causeway Bridge	Horse brook	Flushing and Corona, Queens	7.30	"	30,000
9	Little Neck Bridge	Alley creek	Broadway, Queens	4.31	"	20,000

Bridges in the Borough of Richmond.

1	Lemon Creek Bridge	Lemon creek	Bay View avenue	6.11	Draw	$6,000
2	Fresh Kills Bridge	Richmond creek	South Broadway	5	Swing and trestle	40,000

* Under construction.

APPENDIX B.

Report of Board of Experts on Injury by Fire to Cables of Williamsburgh Bridge.

New York, January 10, 1903.

Commissioner of Bridges,
Park Row Building, New York:

Sir—Under date of November 14, 1902, we were appointed by you, with the approval of his Honor the Mayor, a board of engineers for the following purposes:

1. To recommend and report to you to what extent and in what manner repairs should be made to the steel-wire cables and to the other steel work of the Williamsburgh Bridge damaged by the fire of November 10, 1902, and to formulate specifications for such repairs; and

2. To recommend and report to you a system of fireproof flooring for the Williamsburgh Bridge, under the existing limitations of carrying capacity on the main structure, from anchorage to anchorage.

We now have to advise you that immediately on receipt of your letters we arranged to begin the work which we were requested to attend to. We met first on the morning of November 18, at the Manhattan end of the bridge, visited the top of the tower where the fire occurred and then went to the engineer's office, in Williamsburgh. We outlined a scheme of tests to be made of wires in the bridge, under the direction of Mr. O. F. Nichols, Engineer in Charge, and addressed a letter to him, of which a copy was also sent to you.

Since that time the Commission has held nine meetings. The time occupied in securing the wires and in making tests proved longer than was anticipated, the difficulties having been aggravated by the bad weather which followed our appointment. In all, 538 tests, representing 28 separate wires, have been made at the engineer's office in Williamsburgh, and these have been supplemented by 16 tests, representing 4 different wires, made at the laboratory of the Rensselaer Polytechnic Institute at Troy.

We now submit a report on the injury caused by the fire to the steel wire cables and other steel work of the bridge, with recommendations as to the extent and manner in which repairs

should be made on the same, reserving the consideration of a system of fireproof flooring for the Williamsburgh Bridge to be covered in a future report.

The fire occurred at the top of the Manhattan tower. The injury caused directly by this fire was confined to the top of the tower. Some indirect injury was done to the steel work by the falling of heavy steel bolts which were stored on top and which in falling struck some of the less important members; the injury done in this way does not impair the real strength of the structure.

The most important of these injuries to the steel is on inside girders, which are really struts, at the top of the tower. We recommend that all these injuries be made good by methods which will make no change in the design or appearance of the work; that all bent angles or bruised tie plates or other injured pieces shall be cut out and replaced by new sound pieces, and that the tower be restored, both as to appearance and dimensions, to its condition before the fire.

The fire also destroyed the temporary blocking of the saddles, allowing them to move forward, thereby dropping the main cables on the so-called foot bridge, the cables of which broke under the increased weight, and the foot bridge fell except so far as it was held by the suspenders on the main cables. The wreck of the foot bridge was the most conspicuous result of the fire, but it had no effect on the strength of the permanent structure, and need not be considered here.

The fire appears to have originated between the saddles carrying cables A and B, A being the most southerly of the four cables. This fire communicated to the filling over these cables on top of the saddles, and the upper wires of both these cables on the saddles were evidently heated to a red heat which burned off the oil covering and annealed the steel. The direction of the wind turned the fire towards the river span, and no injury was done to either cable on the land side of the saddle. The steel-plate covering on cable A extended up to the saddle, and this covering protected this cable from the fire, the injury being confined to the upper portion on the saddle. The steel-plate covering had not been put on cable B, and the fire heated the under part of the cable on the river side of the saddle, affecting the wires in the same way that the top wires were affected over the saddle.

The fire reached the north end of the tower and destroyed the blocking connections, which permitted the saddles to move forward and drop the main cables on the foot bridge, but did not reach the cables, the wires of which are unhurt.

In every instance where wires were tested the tests were not confined to the injured portion of the wire, but were extended so that the injured wire might be compared with the same wire uninjured; in the case of the upper wires the tests covered a considerable length of wire on each side of the injury; in the bottom wires this could not be done, as the wires could only be removed up to the saddle, but a considerable length of wire on the river side was always taken so that a similar comparison could be made. In the case of the upper wires the weakest point was generally found near the east quarter of the saddle; in the case of the lower wires the weakest point was generally found very close to the saddle.

Each cable contains 37 strands, each strand containing 208 No. 6 wires, making a total of 7,696 wires in each cable. The specifications required the wire to have an ultimate strength of 200,000 pounds or more to the square inch. It generally ran much higher, averaging from 8 to 10 per cent. more than the specifications required, this corresponding to an ultimate strength of from 216,000 to 220,000 pounds, while some individual wires were materially stronger.

The wires were given a coating of oil which was baked on before they were tested and placed in the bridge. Where they were not heated enough to destroy this coating of oil they do not appear to be injured, and the integrity of this oil coating seems to be a satisfactory evidence of the integrity of the wires.

The result of heating the wire was to anneal it and also to lengthen it, the heated wires being more or less bowed out of their true positions. Annealing reduces the strength, the degree of reduction varying with the completeness of the annealing. The strength in extreme cases has been reduced to about 80,000 pounds per square inch, which was about the ultimate strength of the steel from which the wires were drawn. The effect of the heat has been greatest in the outer layer of wires, and is almost as great in the second layer; it is much less in the third layer, and practically disappears in the fourth layer. A full record of all

these tests is preserved in the engineer's office. A summary of these 28 wires is given in the following table:

No. of Wires.	Layer.	Ult. Strength Uninjured Wire, Pounds Per Square Inch.	Least Ult. Strength Injured Portions, Pounds Per Square Inch.	Percentage Loss of Strength.
15	First	223,800	89,900	60
4	Second	212,500	110,400	48
6	Third	221,700	164,300	26
2	Fourth	234,000	210,500	10

Five of the upper layer wires were from cable A; the other 22 wires were from cable B. The twenty-eighth wire was from the fifth layer and showed no appreciable weakening.

The experiments made at Troy confirmed the accuracy of these tests, but their principal value lay in the fact that by the use of micrometer readings the elastic limit and the modulus of elasticity were more accurately determined. The results of these tests are given in the following table, in which the lowest results of the burned wires have been compared with the highest results of the uninjured wires.

No. of Wires.	Elastic Limit Uninjured Wire, Pounds Per Square Inch.	Least Elastic Limit Injured Wire, Pounds Per Square Inch.	Per Cent. of Loss.	Ult. Resistance Uninjured Wire, Pounds Per Square Inch.	Least Ult. Resistance Injured Wire, Pounds Per Square Inch.	Per Cent. of Loss.	Modulus Elasticity Uninjured Wire.	Least Modulus Elasticity Injured Wire.	Per Cent. of Loss.
1	149,600	70,000	53	220,800	99,100	55	27,540,000	27,000,000	2.0
2	149,100	95,500	36	229,500	121,500	47	27,480,000	26,300,000	4.3
3	146,200	82,500	44	222,400	102,200	54	26,086,000	26,440,000	—1.3
4	149,900	57,400	62	209,800	95,600	55	28,100,000	26,884,000	4.3
Averages..	148,700	76,350	49	220,625	104,600	53	27,301,500	26,656,000	2.3

It will be observed that the modulus of elasticity has not been materially affected, which means that the injured wires will continue to work with the others, although with a much smaller margin of safety.

A count has been made by Mr. Nichols' assistants of the injured wires in each cable, which count is probably ample and may be somewhat reduced when the actual wires are removed. This count indicates that in cable B 500 wires have been affected by the fire, one-half of which are on top of the saddle and one-half on the bottom of the saddle. The former can be replaced, the latter cannot. In cable A the injury is confined to the top, and the whole number of injured wires is stated as 200.

The injured wires on top of the cables can be cut out and replaced by new wires spliced to the uninjured ends in the same manner that the wires in the main cables of the bridge are spliced except that cut threads instead of rolled threads must be used on the ends of the wires. Splices of this kind will develop 95 per cent. of the strength of the wire, but as the actual working of the wire will depend on securing a uniform tension, which presents difficulties for which some allowance must be made, we have considered that the strength of the spliced wires should be estimated at only 90 per cent. of that of the unspliced wires, a reduction of 10 per cent. in their strength. Care should be taken to distribute the splices so as not to form bunches and irregularities in the cables.

The injury to the wires on the under side of the cable is so close to the saddle that this method of repairing is impossible; a splicing wire could be coupled to uninjured wire only at one end. The best that can be done with these wires is to cut them and draw them tight so that they will work with the other wires of the cable, but have an impaired strength. This cutting should be made far enough from the saddle to be done on uninjured wire, the splices in the uninjured wire being considerably stronger than the unspliced injured wire. The condition must be accepted that the strength of the wires which have been injured by fire on the under side of cable B cannot be restored.

In the present condition of the bridge 200 wires of cable A may be considered injured, and these wires are worthless in their present slack condition. These wires, however, are all on top and can be restored to 90 per cent. of their original strength by splicing. The injury to this cable is therefore equivalent to the destruction of 20 wires.

Five hundred wires are injured in cable B which are useless in their present slack condition. Two hundred and fifty wires, being those on top of the cable, can be spliced with a loss of 10 per cent.

of their original strength, so that the injury to these wires will be reduced to the equivalent of 25 wires. The other 250 wires cannot be restored and can only be tightened with their present strength. The injury then on the basis of the tests may be estimated as follows:

100 wires in lower layer, injured 60 per cent., equivalent to 60 wires destroyed.

100 wires in second layer, injured 48 per cent., equivalent to 48 wires destroyed.

50 wires in third layer, injured 26 per cent., equivalent to 13 wires destroyed.

To this should be added 5 per cent. of the strength of the original wires for imperfect adjustments or the equivalent of 13 wires, this making the total injury to the under side of the cable equivalent to 134 wires. If to this be added the injury to the top wires the total is equivalent to 159 wires.

The equivalent number of wires in cables A and B will then be stated in the following table:

Cable.	Before Fire.		After Fire.		After Repairing.	
	Wires.	Per Cent.	Wires.	Per Cent.	Wires.	Per Cent.
A..........	7,696	100	7,496	97.43	7,676	99.74
B..........	7,696	100	7,196	93.53	7.537	97.95

It will be observed that in their present condition cable A is 2.5 per cent. weaker than before the fire, and cable B 6.5 per cent. weaker than before the fire. That after repairing, cable A will be only one-quarter of one per cent. weaker than before the fire, and cable B will be 2 per cent. weaker. As the steel in the wires will average from 8 to 10 per cent. higher than the requirements of the specifications (200,000 pounds per square inch), cable B even in its present injured condition is stronger than the requirements of the specifications.

On the other hand, the injury to the cables has occurred in the part of the cables where the strains are greatest. With this form of wire cable construction the section of cable is everywhere uniform and its size determined by the strains where the inclination is greatest, immediately adjoining the saddle. If eye

bar chains were used permitting of variations of section, the dimensions of the chains would be about 9 per cent. larger here than at the centre. In every structure some margin is expected above the minimum required by the specifications and when an inquiry of this kind has occurred it is desirable, if possible, to restore the structure to the same strength that it had before the injury. To do this, in addition to the repairs already outlined, 20 wires must be added to cable A and 159 wires to cable B. Furthermore, some arbitrary allowance should be made for the imperfect connection which these new wires will have. If this arbitrary allowance is put at 25 per cent., 25 additional wires must be added to cable A and 200 additional wires to cable B. The actual number of additional wires required will be subject to revision when the repairs of the injured wires are completed and exact number finally known.

These additional wires must be added to the top of the cable where it passes over the saddle. The difficulty lies in connecting them with the cable, and this attachment can only be made by friction. The method of making this attachment which commends itself most to us is to place a series of bands, each made in two parts, around the cable, clamped to the cable by steel bolts, the upper half of each band to have a series of holes in it through which the reinforcing wires would pass, being held and adjusted to strain by nuts at the ends, these nuts to be somewhat similar in character to the coupling used to connect the cable wires. The design for these bands should be made with great care. The clamping bolts should be of such size that when these bolts are screwed up to a strain of 20,000 pounds per square inch the pressure exerted by the band on the cable would be ten times the working strain of the wires; in other words, the bands should not slip with a coefficient of friction of 10. Besides the friction created by the tension in the bolts the attachment of the wires near one edge of the band would cause the band to bind, which would materially increase the strength of the connections. It is not considered feasible to attach more than 20 wires to one band, while there should be an additional band covering all the wires. This would involve three bands on each side of the saddle on cable A and eleven on cable B. The bands should be placed about an inch apart, so that each band will act independently of the others in securing its own grip. On the river side the last band should be placed close to the first suspender clamp, the other bands being

between this and the saddle. On the land side the bands should be placed at the same distance from the saddle. Every band should pass outside of all the wires which are coupled to bands beyond it, thus giving additional friction to those wires. On cable B the first band would cover 200 wires, none of which would be fastened to it; the second band would cover 100 wires and 20 wires would be fastened to it, the last band but one would cover 20 and 20 wires would be fastened to it, and the last band would cover no wires, but 20 wires would be fastened to it. The 11 bands will occupy a space of about 12 feet. As an additional security, we advise that the 15 feet of cable adjoining these bands be wrapped with wire drawn as tight as possible, so as to further increase the adhesion of the additional wires to the old.

The repairs of the cables will then consist of three separate operations, the splicing of the injured wires on top, the tightening of the injured wires on the bottom and the addition of new wires. The two first of these operations should be performed as soon as possible. The additional wires could be put on immediately thereafter, but the final tightening of the bands and the wire wrapping should be deferred till the cables are carrying a full load.

The effect of fire on high-tempered wires like those in the Williamsburgh Bridge is so great that too much care cannot be taken to prevent fire reaching them, and we would recommend that wherever, for any purpose, it is necessary to keep an appreciable amount of combustible material near the cables, some provisional protection be made, to prevent fire reaching them if it should occur.

We have endeavored in this report to cover the injury to the cables and the method of repairing the same. If any points have escaped us we shall be glad to give them further attention if you desire. We hope to submit our report on the matter of a fireproof flooring within a short time.

We have the honor to remain,

Very respectfully,

GEO. S. MORISON,
C. C. SCHNEIDER,
L. L. BUCK.

APPENDIX C.

Report of Board of Experts on Fireproof Flooring for Williamsburgh Bridge.

New York, January 24, 1903.

Commissioner of Bridges,
Park Row Building, New York:

Dear Sir—On the 10th we sent you a report covering the fire damage to the steel cables of the Williamsburgh Bridge with suggestions for strengthening and repairing the same. In your letter of the 14th you ask whether we would recommend covering up with a steel envelope the clamp bands which in our report we suggested be placed on the cables near the towers. We consider that it is expedient to cover these clamp bands completely with the same kind of covering that incloses the main cables. On the other hand, we think that this final covering should be deferred until the completion of the entire structure so that the working of the additional wires and the action of the clamps may be observed. Moreover, after the bridge has been subjected to something like a maximum load so that the cables have taken their final shape, the bolts uniting the two sections of the bands should be tightened up again, and if it appears necessary the wires should be readjusted. After this the covering should be put on. We send herewith a plan showing the details of the clamp which we think it best to use.

In our report of January 10th we confined ourselves to the injury caused by the fire and the manner in which the repairs of the injured cables should be made. We now submit a supplementary report covering our recommendations for a system of fireproof flooring under the existing conditions of carrying capacity on the main structure from anchorage to anchorage.

The flooring of the Williamsburgh Bridge consists of three separate features:

1. The roadway floors for horses and vehicles.
2. The railroad floor.
3. The footwalks.

Each of these will be considered separately.

Roadway Floors—The cross section of the bridge as originally designed shows two roadways, each 20 feet wide between curbs, carried outside the main trusses and cables by projecting canti-

lever arms on the floor beams. The longitudinal stringers are riveted plate girders which carry transverse channel bars to which the wooden floor of the original design was to be attached. The floor beams, stringers and transverse channels are in position everywhere except on the main span between the towers.

The plan of roadway suggested by Mr. O. F. Nichols, Engineer-in-Charge, with some slight modifications, is recommended as well adapted for fireproof construction on this portion of the bridge. This plan consists of a series of 12-inch channels laid flat with the flanges down and fastened to every transverse channel by a riveted bent plate, the channels being placed about half an inch apart and when laid presenting a flat upper surface. The plan also provides for a steel curb constructed of two 12-inch channels with a cover plate on top. We have verified the calculations and consider this metal work strong and satisfactory.

On this metal work we advise laying a wooden pavement formed of blocks of Southern pine 4 inches high and not more than 4 inches thick, thoroughly creosoted and laid immediately on the steel surface. In this position any destructive fire in the wooden portion of the floor would be impossible. The non-conducting wood pavement would prove a protection to the iron below in case a fire were built on top of it.

The estimated weight of this floor per lineal foot of roadway is as follows:

Steel work	525 lbs.
Paving blocks (6.67 cubic feet), at 60 lbs. per cubic foot	400 "
Total	925 lbs.

The estimated weight of the timber floor of the original design consisting of 5-inch oak planks laid lengthwise with timber curb on each side and angle wheel guards was 775 pounds per lineal foot. Each roadway under the new plan will therefore weigh 150 pounds more than the original design, the two roadways adding 300 pounds per lineal foot to the weight to be carried by the cables.

Railroad Tracks—The cross section of the bridge provides for six railroad tracks, of which the two central tracks are designed to carry trains of the elevated railroad and the two side tracks the surface trolley cars. When the cross section of the bridge was determined, it was expected that the elevated trains would be

drawn by locomotives and provision was made for the heavy weight on locomotive driving wheels. Before this bridge is completed all the elevated trains will be driven by electric motors, arranged on the multiple unit system, and no steam locomotives should ever be allowed to cross the bridge. Under these conditions the weight per axle will not differ materially on any of the tracks and we have thought it best in our designs and calculations to provide for six tracks of the same strength and capacity. Of these tracks the two centre ones would carry trains probably of six cars, receiving their power from a third rail. The cars on the four outer tracks would receive their power from an overhead trolley wire.

The floor as originally designed consists of 8-inch by 8-inch wooden ties resting on steel stringers 6.5 feet between centres carrying 65-pound steel rails, the general details of which are similar to those in common use on railroad bridges. The stringers are in position everywhere except on the main span. The problem before us, therefore, consists in the substitution of a less combustible construction for the timber floor on top of the stringers. If the gauge of the rails was the same as that of the stringers it would be a comparatively easy thing to place the rails with their local supports directly on top of the stringers and to make a floor which would be somewhat lighter than the wooden floor originally designed. Under existing conditions this cannot be done and a plan has been worked out in which the panels (about 20 feet long) are subdivided into three equal parts by cross bearers, each formed of a pair of 5-inch Z bars, carrying longitudinal stringers, each formed of a pair of 10-inch Z bars, the lower flanges being turned together, and the upper flanges being stayed over the cross bearers by brace plates. The lower flanges would carry short timbers on which the rails would rest and which take the place of ties so far as the rail bearings are concerned. They would be held at their proper places by lag screws passing through the webs of the Z bars and the rails should be fastened to them by some form of screw bolt. The Z bars form at once girders and guard rails; they are placed far enough from the rail to permit a wheel to drop between the guard and the rail in case of derailment. The fibre strain in the steel of the Z bars is limited to 8,000 pounds per square inch of net section with 24,000 pounds on a single axle. The spaces between the Zs, both in the middle of the track and between the tracks,

would be covered with a light iron grating which would enable men to walk on it and prevent articles dropping through in case of accident.

The only combustible material in the track would be the short timbers under the rails. These are not continuous, and are so situated that while one of them might be burned the fire could hardly extend beyond the limits of its immediate origin.

We also advise laying all the tracks with an 80-pound rail (Am. Soc. C. E. section), instead of the 65-pound rail of the original design.

The estimated weight per foot of bridge of the six tracks is as follows:

Rails, 80 lbs. per yard, and fastenings	410 lbs.
Z bar cross bearers	180 "
Z bar stringers	480 "
Braces, tie plates, etc.	130 "
Gratings	450 "
Wooden blocks	100 "
Total	1,750 lbs.

making for the six tracks 1,750 pounds per lineal foot of bridge. The estimated weight of the original floor for the six elevated railroad and trolley tracks was 1,500 pounds per lineal foot of bridge, the modifications increasing the weight 250 pounds. A detail plan of this form of floor accompanies this report.

Another plan was considered which would be somewhat less expensive, but uses more combustible material, in which the timber ties were spaced about two feet between centres and all the longitudinal members made of steel. This would make track laying very simple and reduce the danger of fire, but it is not as fireproof a construction as that recommended.

Footwalks—The original design for the footwalks provided a walk 17.5 feet wide on each side of the bridge, immediately over the trolley tracks, this footwalk being carried on steel stringers which are now in position except on the main span. This footwalk was divided by a railing into two parts, one designated as a footwalk and the other as a bicycle path. The approaches to the bicycle path have materially heavier grades than the roadway approaches, and it is very doubtful whether this bicycle path will be used to an extent which will justify its maintenance. The floor of the footwalk was designed as a simple floor of 2-inch

Southern pine planks nailed to longitudinal strips fastened to the top of the steel stringers and estimated to weigh 337 pounds per lineal foot of bridge, or a little less than 10 pounds per square foot.

Two possible substitutes for the planks have been suggested. One is a material known as lignolith, which is manufactured by the Franke-Jenner Fireproof Flooring Company in Williamsburgh. The makers of this material have proposed to furnish it in slabs of suitable size to rest directly on the stringers. Tests have been made of this material under our immediate supervision on the premises of the Hecla Iron Works in Williamsburgh. A single slab 2 1-16 inches thick and 3 feet between supports carried a distributed weight of 3,106 pounds with no apparent injury, this weight being 521 pounds per square foot. Under this load the slab deflected 5-16 of an inch at the centre, but recovered its original form when the weight was removed. It had what is called an excelsior core and a top and bottom surface 5-16 inch thick of lignolith in the most compact form. It was entirely without any wire or steel armoring. This material has some decided advantages, one of which is the character of its surface, which is not likely to be slippery. It would probably weigh about 15 pounds per square foot, including all fittings.

The other material consists of slabs of armored concrete, formed of Portland cement, sand and some form of metallic meshing, which would be laid in the same way, directly on the stringers. The weight of this material would be a trifle more than that of the lignolith. It would not have as good a surface to walk on.

In view of the comparatively untried character of lignolith and the fact that the footwalk will be the last portion of the bridge required, we advised that experiments be tried with lignolith in service, and if these are satisfactory, that it be adopted for the floor of the footwalks. These experiments should be made in two ways. A section of lignolith should be laid down in an exposed position on the sidewalk near the Williamsburgh office where it would be observed continually by the engineers. Another section should be laid down on the iron work of the approach to the old Brooklyn Bridge in a position where it would get an extreme wear. Both pieces would be exposed to the weather and to mud. If these tests of lignolith prove satisfactory, we recommend its adoption for the floor of the footwalk. Should

they not prove satisfactory, we should advise using armored concrete.

Either of these plans will add to the weight of the footwalk. This additional weight can, however, be made up for by narrowing the footwalk, and we advise that the bicycle path be omitted and that two separate footwalks, each 10 feet wide, be placed on each side of the bridge, thus saving the weight of nearly 8 feet of floor, of 4 lines of stringers and 2 railings. With this change the fireproof floor of the footwalk would weigh 100 pounds less than the wooden floor of the original design per lineal foot of bridge.

The results of these modifications will add the following weights to the dead load to be carried by the trusses and cables of the Williamsburgh Bridge :

Roadways	300 lbs.
Railroad tracks	250 "
	550 lbs.
Footwalks, saving of	100 "
	450 lbs.

The total dead load according to the original design was estimated at 16,620 pounds per lineal foot, so that this addition makes an increase to the dead load of 2.71 per cent. The estimated live load was taken at 5,700 pounds, making the estimated total load 22,320 pounds per lineal foot, so that the change in the floors will add 2.02 per cent. to the total load which the bridge must carry. This addition is not large enough to have any material effect, simply increasing the maximum stresses in the cable from 51,000 pounds to 52,000 pounds per square inch, and the maximum stresses in any portion of the trusses from 17,000 pounds to 17,500 pounds per square inch.

This small increase is entirely dead load, the class of load for which in modern structures the best practice permits stresses twice as great as are permitted for live load. The effect of this increase is practically insignificant, the strain in the cables, even with this increase, being only 35 per cent. of the elastic limit of the wires, and those in the truss members only about one-half of the elastic limit of the steel.

In this connection there is one feature to which we would call attention. A wooden railroad floor interposes an insulating ma-

terial between the rails, which are used for the return electric current, and the steel of the structure. While it is very doubtful whether this insulation would be properly maintained, it should not be overlooked. It would be possible to maintain the same insulation with the design of floor described above, but it would be more difficult. There is no reason to suppose that electricity would injure the bridge anywhere except possibly in the anchorages, where, in case of defective insulation of the anchor bars, electrolysis might occur. To avoid this danger we think that the Brooklyn Rapid Transit Company or any other tenant should be required before running its trains across the bridge to provide suitable copper conductors to be connected with the main bearing rails, in much the same way that the feed wires are connected with the third rails, and properly grounded at each end of the bridge. We also consider that a proper conductor, of at least 1-inch section, should be laid to connect the anchorage end of each cable with the water of the East river.

Accompanying this report are four plans, as follows:

1. Proposed clamp for reinforcing wires.
2. Proposed floor for roadway.
3. Proposed steel floor for elevated and trolley tracks.
4. Proposed floor to cover spaces between track stringers.

These are sent in the form of triplicate blueprints.

Very respectfully,

Geo. S. Morison,
C. C. Schneider.

APPENDIX D.

Approval of Plans of the Manhattan Bridge.

Whereas, Under date of January 29, 1900, the Secretary of War, under authority of section 9 of the River and Harbor Act of March 3, 1899 (30 Stat. L., 1151) approved the location and plans of a bridge (designated as Bridge No. 3) to be constructed by the Department of Bridges of The City of New York, New York, across the East river, to connect the boroughs of Manhattan and Brooklyn; and

Whereas, The Department of Bridges of The City of New York has now submitted, with request for approval, modified plans for said bridge, which plans have been approved by the Chief of Engineers, United States Army;

Now, therefore, this is to certify that the said modified plans, which are hereto attached, are hereby approved by the Secretary of War, subject to the following condition:

That the Engineer Officer of the United States Army in charge of the district within which the bridge is to be built may supervise its construction, in order that said modified plans shall be complied with.

Witness my hand, this 5th day of January, 1905.

Robert Shaw Oliver,

Assistant Secretary of War.

APPENDIX E.

Report of Board of Experts on the Blackwell's Island Bridge Plans.

"New York, December 10, 1902.

"*Hon.* Seth Low,
Mayor:

"Sir—In accordance with your instructions of November 3, 1902, the Commission appointed by you to consider certain features of the plans proposed for the Blackwell's Island Bridge, organized and began its sessions on November 7, 1902. All the plans and data available in the Department of Bridges were courteously placed at our disposal by the Commissioner of Bridges, and were carefully examined and considered in the course of the Commission's investigations. The Commissioner appeared before the Commission to set forth such explanations of the various features of both the original and the modified plans, and to make such further explanations as were necessary or advisable for a thorough and complete examination of the matters in question. Mr. Foster Crowell, C. E., engineering representative of the Committee of Forty of Queens County, also appeared before the Commission to make argument in behalf of that committee and to present such data and considerations as he deemed advisable. The Commission also visited the Long Island end of the site of the bridge. Finally, Mr. R. S. Buck, C. E., formerly Chief Engineer in Charge of the Blackwell's Island Bridge during the inception and preparation of the original plans, came before the Commission to make such statements and to present such information as might seem desirable to him as the responsible engineer in the preparation of those plans.

"The questions to be answered by the Commission will be considered in the order employed in your letter of instructions:

> "1. How does the capacity of the bridge proposed by Mr. Lindenthal compare with the capacity of the bridge as originally planned? Is it larger or smaller, or substantially the same?

"The Commission understands that this question requires an answer as to the relative capacity of two bridges to pass traffic at the proposed Blackwell's Island location, if designed in accordance with the original and the modified plans, as set before us, without regard to the further consideration whether either plan

would afford too much or too little or just sufficient capacity for the traffic ultimately seeking passage by that structure.

"The original plan provides for two elevated railway tracks on a deck above the roadway floor. The same provision in the same general location is made in the proposed plan. Again, the original plan provides two sidewalks on the lower or main deck, each 10 feet wide in the clear. The modified plan provides two sidewalks on the upper deck, each 11 feet wide in the clear, the proposed plan thus giving 10 per cent. excess of available sidewalk width over the original plan, but against this excess are to be placed the stairways at the ends of the approaches, which decrease the capacity of the sidewalks. Again, the original plan provides four trolley tracks in spaces or lanes exclusively reserved for their use. In the modified plan two trolley tracks only enjoy the use of exclusively reserved lanes, the other two trolley tracks being placed on the roadway without separation from the wagon traffic. Therefore, the capacity of the two plans, as far as the elevated railway tracks, the two sidewalks and two of the four trolley lines are concerned, is so nearly equal that they may be considered substantially the same.

"The two remaining trolley tracks in the original design are entirely separated from the roadway traffic, hence the capacity of the trolley service in the original design is greater than in the proposed design, as no lines can be delayed or detained by the wagon traffic.

"It is a matter of general observation throughout New York City, especially in the most crowded streets, as well as in other large cities, that the traffic in the busiest hours is never equally divided in the two directions, but that the great preponderance of vehicular movement is either in one direction or the other, according to the portion of the day in which it takes place. The accommodation for vehicles, therefore, as a class, must be so provided as to meet the requirements of this greatly unbalanced movement. As a result of extended observation on the densest and most bulky traffic of the streets of this city, and on the New York and Brooklyn Bridge, it may be at least approximately stated for purposes of comparison that availability of roadway space may be determined by dividing the roadway into lanes not less than 9 feet wide, that width being sufficient to accommodate the widest or bulkiest trucks or vans moving in the city streets.

"The roadways in the original design are of sufficient width for four such lines of wagon traffic, whereas the proposed design does not show quite sufficient capacity for three such lines, excluding the trolley tracks, which certainly should be excluded in getting their maximum capacity. As shown by the above statement of unbalanced traffic, the four lines allowed by the original design would probably rarely be used to their full capacity, yet, in any case, there will always be passageway for two lines of unobstructed traffic in one direction and one line in the other direction, and this is greater than can be secured under the best of circumstances in the proposed design.

"It is thus seen that the total aggregate capacity of the original plan is greater than that of the proposed plan.

"The second question which you submitted to the Commission is:

"2. Which of the two bridges is, in your judgment, "preferable; taking capacity, efficiency and beauty all into "consideration?

"The answer to Question 1 fully covers that part of this question relating to capacity.

"In comparing the efficiency of the designs we have considered the following characteristics: Superiority in handling traffic; the facility with which passengers may take other means of transportation in case of accident, the possibility of accident due to any arrangement of the passageways for different kinds of traffic; the attractiveness of the various lines of traffic for the purposes for which they are intended; the general arrangement of the members of the bridge trusses and floor system to insure the greatest rigidity and durability, and other conditions calculated to attract traffic of any or all kinds, or to render its passage more economical, agreeable or expeditious.

"Beauty in a bridge of this magnitude is mostly arrived at by a proper arrangement of the main lines of the trusses and harmony between the component parts of the structure; all smaller details can generally be made satisfactory on any design of bridge.

"Taking the relative merits of these three features in their order:

"We find the capacity of the original design to be greater than that of the proposed design, as answered in Question 1.

"As to efficiency; it is our opinion that the trolley traffic should be completely separated from the roadway traffic, as found

in the original design, so that the speed of the trolley cars shall not in the least be interfered with by the wagon traffic. We further believe that the roadway should be in one clear width, without obstruction of any kind, as found in the proposed design. In the original design the sidewalks, being on the lower deck, are in the best position for taking care of the passengers in case of accident on any of the four trolley lines, but in case of accident on the elevated road it would be difficult to take care of the passengers; whereas, in the proposed design, in case of accident, all the trolley and elevated railway passengers are taken care of. In the proposed design the sidewalks are shown on the upper deck, and while we believe this has advantages as to attractiveness for pedestrians, it is well known that in case of great crowds stairways may be a source of danger at the entrance of such structures.

"It is our opinion, from inspection of the drawings of the original and proposed designs, that the feature of beauty has been given considerably more attention in the proposed design than in the original, and that the general outline in the proposed design is more satisfactory than in the original design. On the other hand, placing a bridge of the proposed width on piers designed for a much wider structure involves difficulties as to appearance not yet satisfactorily solved in the proposed design.

"In view of the preceding statements the Commission is reluctant to make unqualified answer to this question, not regarding either plan in its present condition entirely satisfactory. If choice were unavoidable, two of your Commissioners would favor the original and one the proposed design.

"A plan, however, set forth at the end of this report, can be arranged which will afford more satisfactory capacity and be more efficient than either of the designs submitted for our consideration.

"The third question is:

"Which is likely to be the more expensive structure?

"Your Commission made a careful examination of the plans, both detail and general, so far as they have been prepared, as well as the books in which the computations have been made and recorded. The final detail drawings of neither plan have been completed, nor have they been developed sufficiently to enable accurate estimates to be made. Such data as now exist were availed of, and certain general but approximate computations of weights of steel work were also made by the Commission. These quantities of

materials are affected to a considerable extent by the character of floor employed, both for the highway and trolley and elevated railways. These approximate estimates were based on the supposition that buckle plate and asphalt, or other similar permanent floors, should be used for all portions of both decks. The results of these approximate computations indicate that the difference in costs of the two plans developed on similar general lines, as to floors and other elements of design, will not be greatly different, but that the modified structure is likely to be less expensive than the original structure.

"In the consideration of these questions, this Commission disclaims either approval or disapproval of either of the two general types of trusses employed in the plans, or of such detail features of a purely structural character as the combined arrangement of piers and steel work above them, as lying outside the scope of the questions requiring answer.

"Having thus answered your questions, we take the liberty of making the following recommendations for the arrangement of this structure:

"That two sidewalks, each not less than eleven (11) feet in clear width, be placed on the upper deck inside of the trusses and adjacent to them; that the two lines of elevated railway be placed on the upper deck, one on each side of the centre line and as close as possible to the sidewalk; that the lower deck be arranged with two trolley lines on overhanging brackets, one outside of each truss, and with two additional trolley lines inside of the trusses, one line being adjacent to each truss; that a roadway be placed in the middle of the lower deck, with complete separation between it and the trolley lines on either side, and that the clear width of this roadway between guards shall not be less than thirty-six (36) feet, and, without columns, requiring a clear width of not less than fifty-six (56) feet between trusses.

"We further recommend that a solid floor on buckle plates be used on the lower deck between the main trusses, and that the lightest practicable continuous fireproof flooring be used on the sidewalks, the two elevated railway tracks and the spaces between the overhanging and the adjacent trolley tracks. The remaining portions of the overhanging trolley tracks should have an open fireproof floor as light as practicable. The central space between the elevated railway tracks should be entirely open to admit light and air to the roadway below. It is the opinion of

the Commission that this material decrease in the dead weight of the floors will fully compensate for the small increase in weight resulting from the increased separation of the trusses without increasing the cost of the structure. It is further the judgment of this Commission that the capacity afforded by this plan is not beyond reasonable provision for the future requirements of the locality served by the bridge.

"WM. H. BURR,
"HENRY W. HODGE,
"PALMER C. RICKETTS."

"NEW YORK, December 13, 1902.

"In answer to your oral inquiry as to the precise meaning of the words 'more satisfactory capacity,' occurring in the seventh line from the bottom of page 5 of our report to you under date of December 10, 1902, regarding certain features of the original and proposed plans for the Blackwell's Island Bridge, we advise you as follows:

"The words 'more satisfactory capacity' mean that the plan set forth and recommended at the end of our report affords the same capacity of elevated railway and trolley lines and sidewalks as in the original plan, but that the capacity of the roadway is greater than that of either the original or proposed plan.

"WM. H. BURR,
"HENRY W. HODGE,
"PALMER C. RICKETTS."

"NEW YORK, January 5, 1903.

"We have received the copy of a letter, addressed to you by Mr. Foster Crowell, under date of December 19, 1902, regarding the proposed position of the sidewalks in the plan of the Blackwell's Island Bridge, as recommended by this Commission in its report to you, under date of December 10, 1902, and we have given careful consideration to the contents of his letter.

"In this letter Mr. Crowell sets forth no new features, nor new considerations regarding the placing of the sidewalks on the lower deck of the bridge. In the hearing before the Commission and in his communications to it he entered into his reasons for believing that the sidewalks should be placed on the lower deck much more fully than in the letter of the above date.

This Commission gave full and deliberate consideration to the facts and the arguments placed before it by Mr. Crowell, and recognized the entire structural practicability or feasibility of placing the sidewalks on either the lower deck or the upper deck. As stated in our report to you, this Commission also recognized the objections which could be made against the steps at the ends of the approaches required to reach the sidewalks, if placed on the upper deck.

"This Commission recommended that the sidewalks be placed on the upper deck and inside of the trusses on account of the advantages to be gained by securing a more elevated plane of view; by removing them from the level of the roadway floor and thus avoiding the dust and dirt and odors emanating from that floor; by placing them above the trolley tracks and the highway traffic, which would practically cut off the view from one direction, a condition aggravated by the partial continuity of the floors on the upper deck; by securing on the upper deck an equally clear view in one direction and a nearly clear view in the other; and by securing bays not less than six feet deep outside of the eleven feet width of sidewalk and between the members of the trusses in which seats can be placed for rest and recreation. This latter feature, in the opinion of the majority of the Commission, is of much value, but cannot be secured if the sidewalks are placed on the lower deck. Again, widening the lower deck will detract from the appearance of the structure. The metal in the floors will probably be slightly less in amount with the sidewalks in the upper deck, although this consideration is of little moment.

"For these preponderating reasons in favor of the elevated sidewalks, the undersigned majority of the Commission finds no ground for modifying the recommendation in its report to you, but confirms the position taken in that report, by recommending that the sidewalks be placed on the upper deck as proposed therein.

"Wm. H. Burr,
"Henry W. Hodge,

"Troy, N. Y., January 5, 1903.

"The third member of the Commission does not concur in all the opinions of the majority expressed in the answer to the letter of Mr. Foster Crowell, addressed to you and dated Decem-

ber 19, 1902, regarding the position of the sidewalks on the proposed design for the Blackwell's Island Bridge.

"The report of the Commission made to you under date of December 10, 1902, in which certain features of the original and proposed designs for this bridge were compared and a third arrangement suggested, was a compromise report. None of the members had the same opinion as the others regarding all the features upon which the Commission was requested to report. The third member of the Commission had decided opinions regarding the best place for the sidewalk, and since this feature of the report has been singled out for a separate answer he deems it advisable and necessary to give his reasons for believing that the sidewalk should be placed upon the lower and not upon the upper floor of the bridge.

"*First*—He believes that most of the foot passengers crossing such a bridge do so for business reasons and for pleasure; probably for economical reasons. Such persons should be particularly considered and should not be compelled to climb stairs unnecessarily. Probably those who walk for pleasure would not prefer stairways.

"*Second*—In crowds stairways are a source of danger. The only accident resulting in loss of life which has ever occurred on a sidewalk of a New York bridge crossing the East river took place at a stairway, and it is believed was a fatal one in consequence of the stairway.

"*Third*—Sidewalks placed on the lower floor outside the trolley tracks would be farther from the dust and dirt and odors emanating for (from) the roadway floor than if they were placed above and almost over the roadway floor.

"*Fourth*—If placed on the lower floor, as suggested, each sidewalk will have a trolley line on one side of it and a clear view of the river, immediately below the railing, on the other. If placed on the upper floor it will have the tracks of an elevated railroad on one side of it, a trolley line beneath it, and on looking over the railing another trolley line, which will cut off a clear view of the river beneath. If the location of the sidewalks had to be settled in favor of the position from which the better view could be obtained, it would seem that neither one had much advantage over the other. It is doubtful whether the upper position has any advantage of this nature: certainly not sufficient to

cause the thousands of foot passengers who will probably use the bridge daily to be compelled to climb stairways as well as ascend a long and high approach.

"*Fifth*—It is believed that the piers for this bridge are to be and are now being built for a bridge designed to be one hundred and twenty feet wide. Artifices objectionable both from an artistic and engineering point of view are sometimes used when a bridge is designed narrower than the piers upon which it is to be placed, in an attempt to disguise the incongruity. If the sidewalks are placed on the lower floor and the bridge thus made of a width for which the piers were designed, no incongruity will result. On the contrary, there will be unity of design, and it is believed that the appearance of the bridge will in consequence be improved.

"*Sixth*—The third member of the Commission agrees with the other members that there is no structural reason why the sidewalks should not be placed in either of the suggested positions, and that any slight difference in cost is of little moment.

"PALMER C. RICKETTS."